



South Dakota Climate and Streamflow Conditions, Watershed Delineation

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USGS-South Dakota Water Science Center

South Dakota Watershed Task Force
Committee Hearing

Pierre, SD
July 23, 2012



Major Topics

Slide 2

- Introduction to USGS in South Dakota
 - Locations
 - Programs
- Changing Climate Conditions
 - Temperature
 - Precipitation
 - Streamflow
- Watersheds
 - Definitions
 - How determined

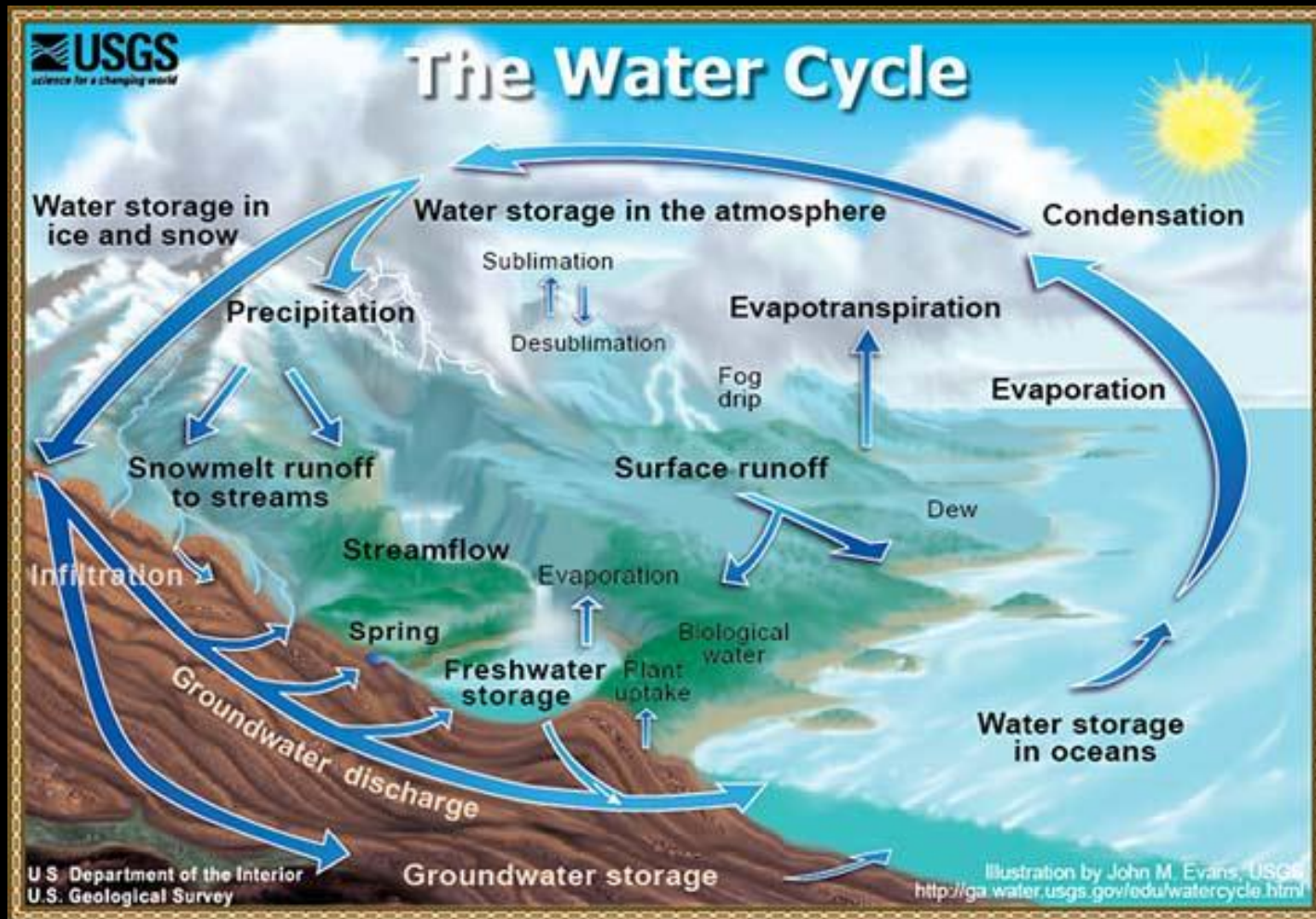


USGS Water Mission

Slide 3

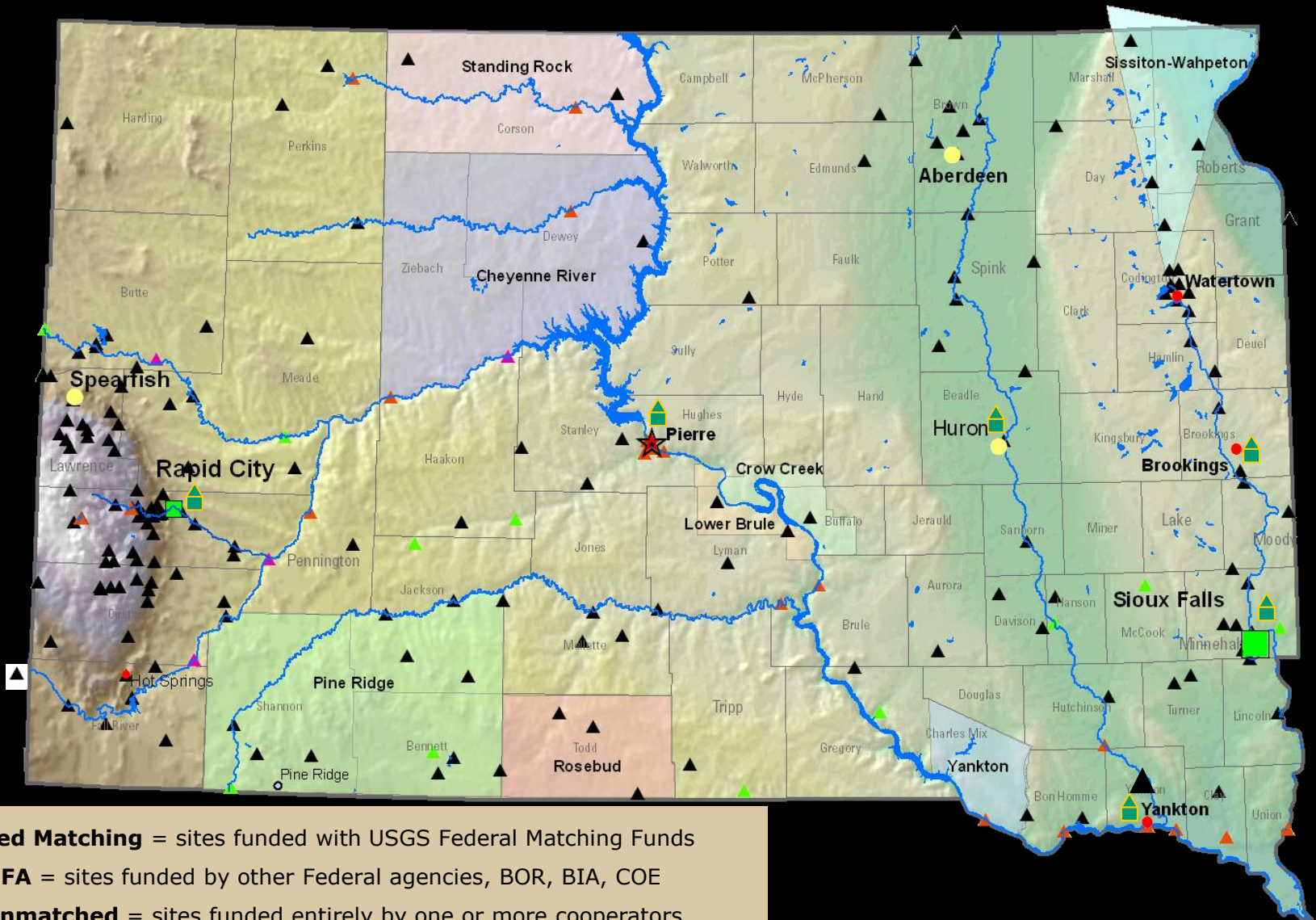
- “The Mission of the USGS Water Discipline is to provide reliable, impartial, and timely information needed to understand the Nation’s water resources through a program of shared efforts and funding with State, Tribal, and local partners to enable decision makers to wisely manage the Nation’s water resources.”

Hydrologic Cycle—our realm of work



South Dakota Streamflow Gaging Network

Slide 8

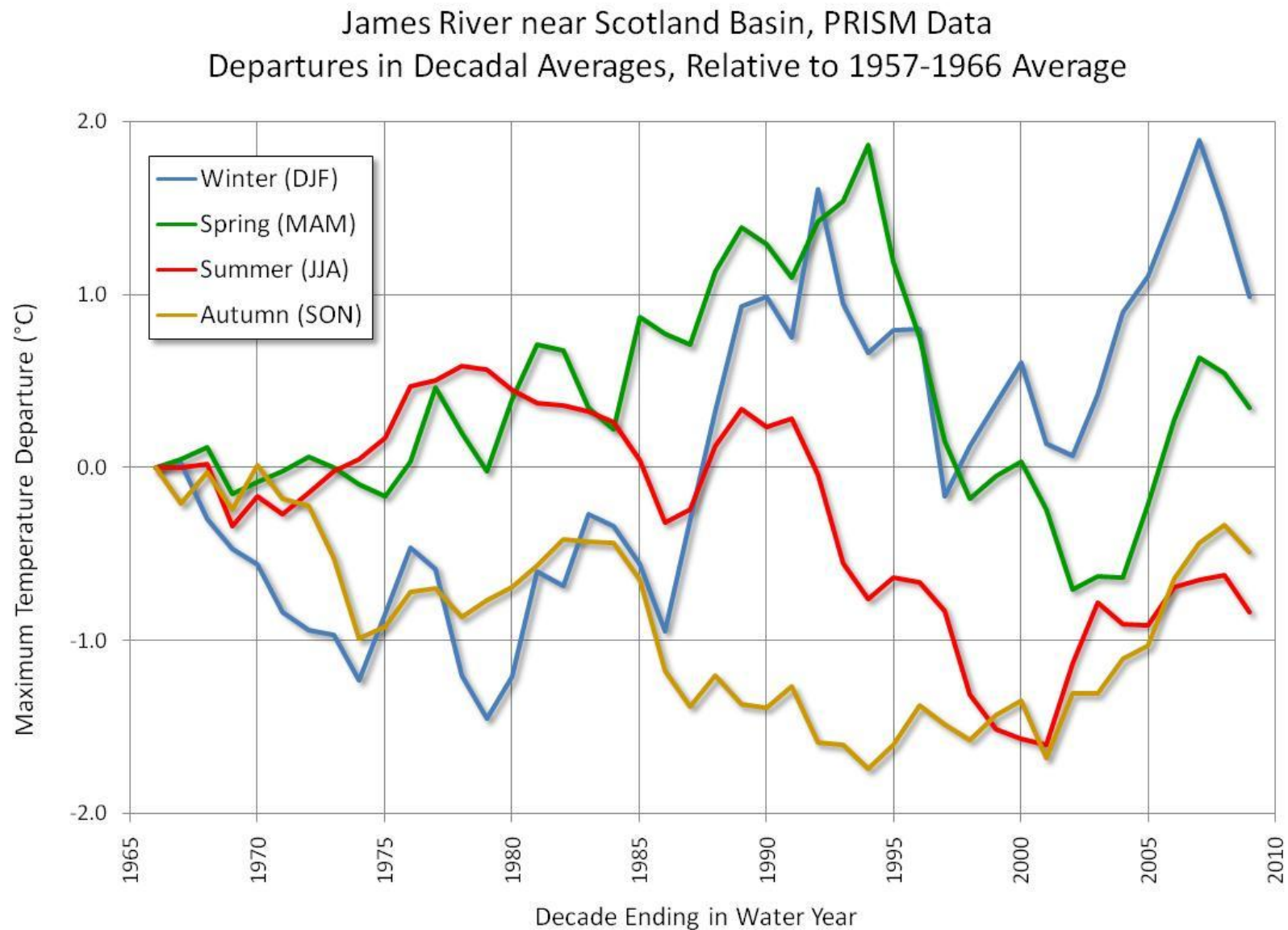


- ▲ **Fed Matching** = sites funded with USGS Federal Matching Funds
- ▲ **OFA** = sites funded by other Federal agencies, BOR, BIA, COE
- ▲ **Unmatched** = sites funded entirely by one or more cooperators
- ▲ **USGS/NSIP** = sites funded by the USGS National Streamflow Information Program

🏠 **USGS Office**

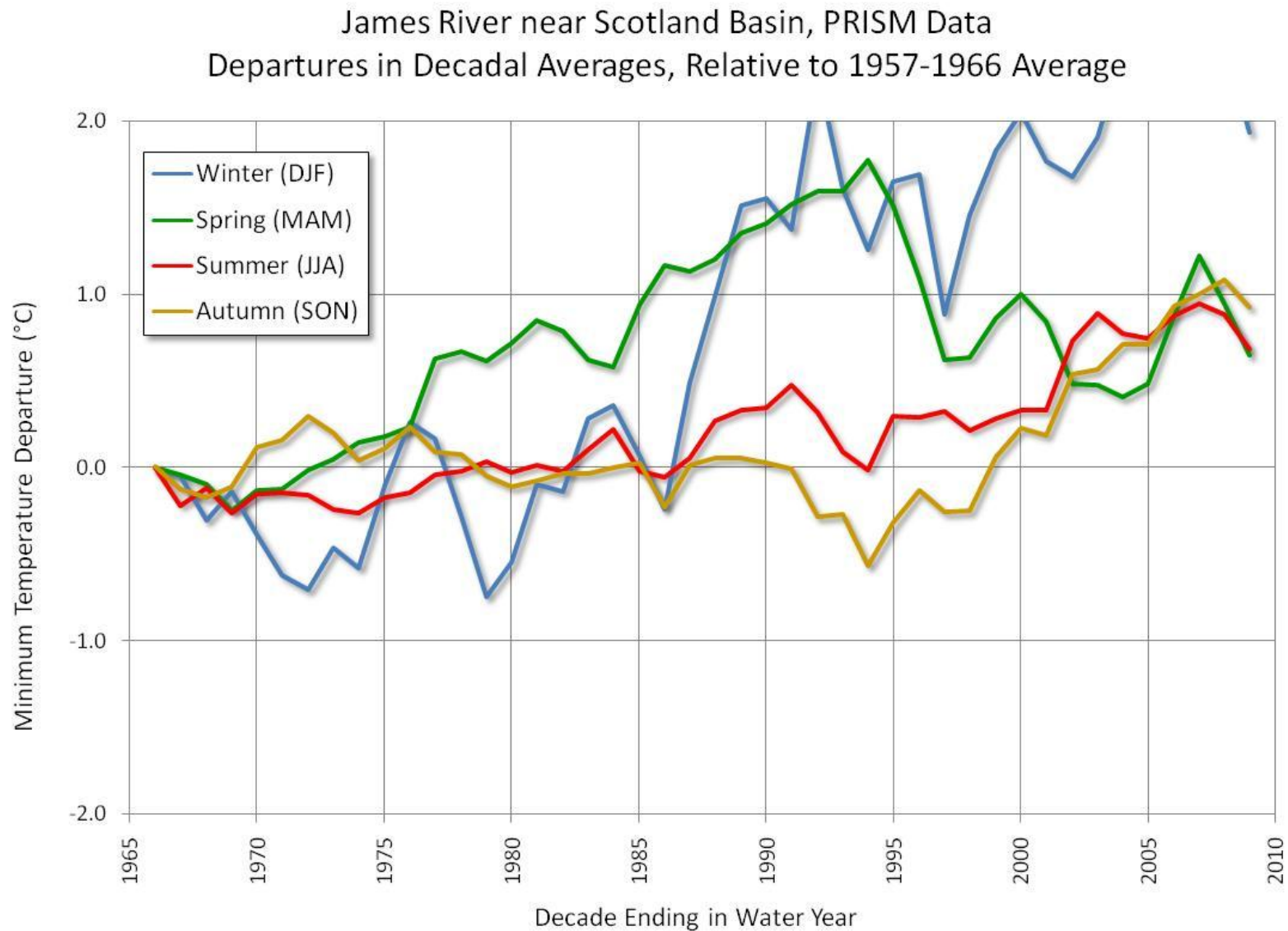
James River Basin—Maximum Air Temperature

Slide 6



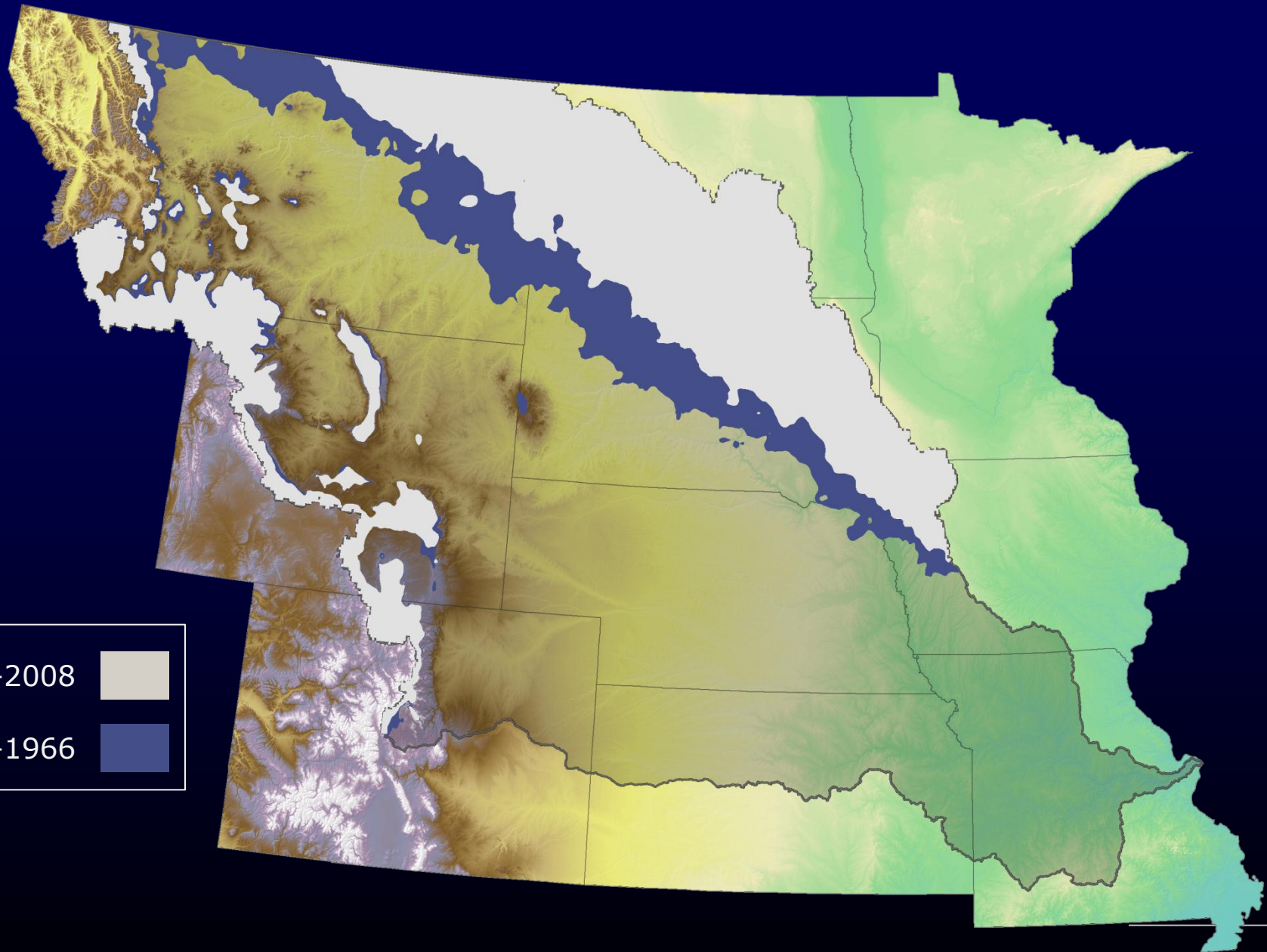
James River Basin—Minimum Temperature

Slide 7



Winter (Dec Jan Feb) Maximum Temperature— Area where Max Temp is below Freezing (0°C)

Slide 8



1999-2008



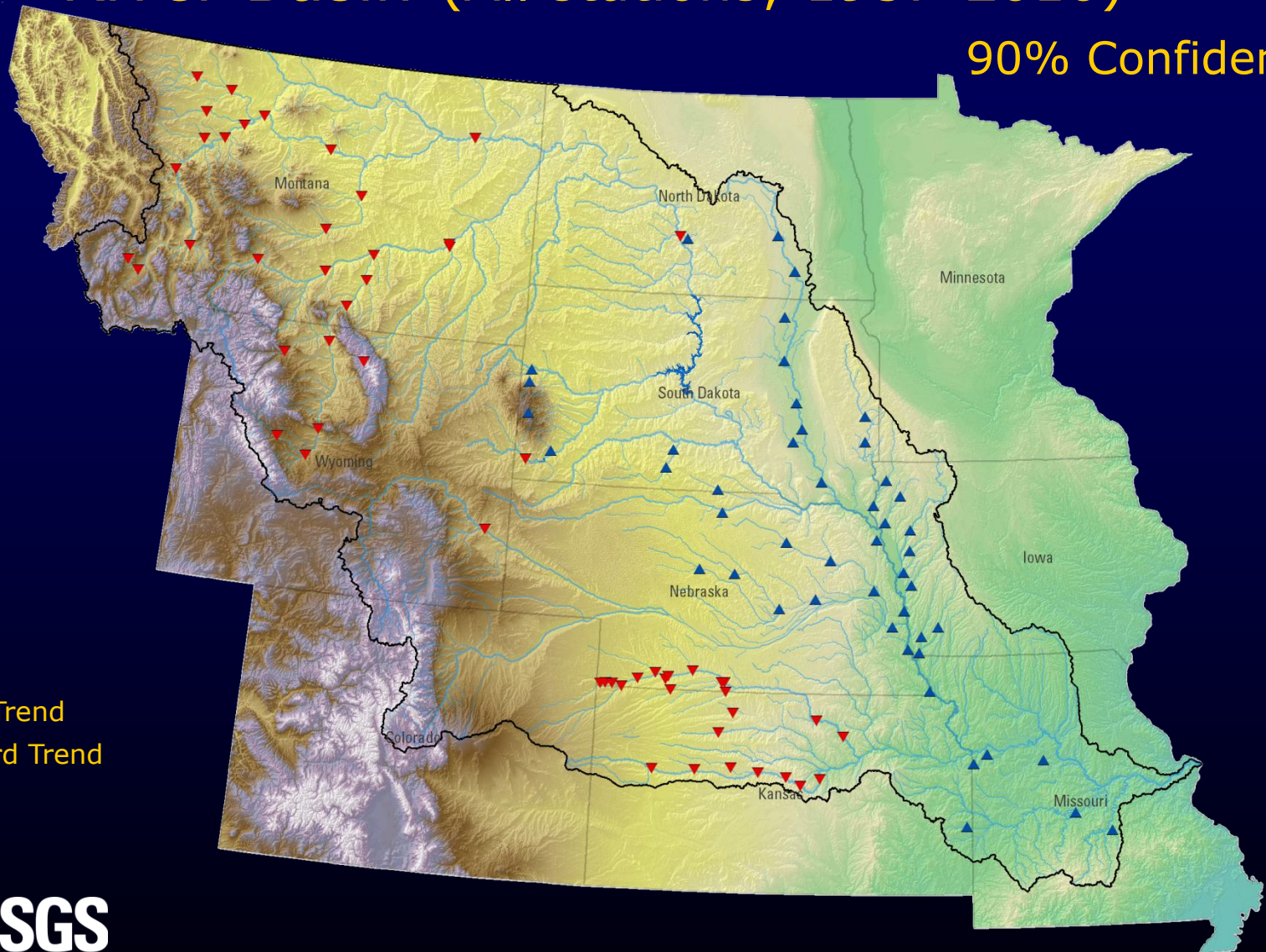
1957-1966



Trends in Annual Streamflow in the Missouri River Basin (All stations; 1957-2010)

Slide 9

90% Confidence

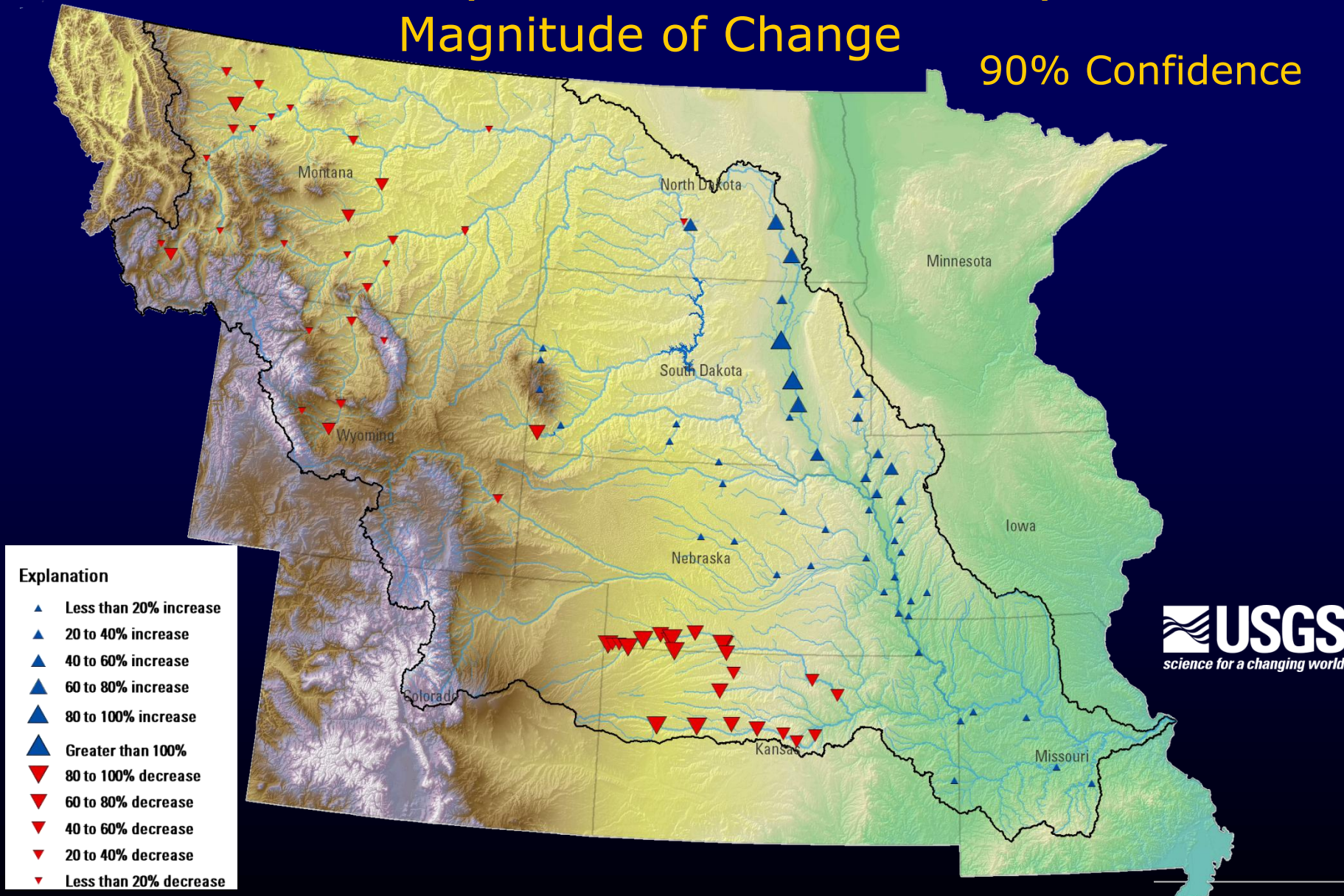


- ▲ Upward Trend
- ▼ Downward Trend

Trends in Annual Streamflow in the Missouri River Basin (All stations; 1957-2010) with Magnitude of Change

Slide 10

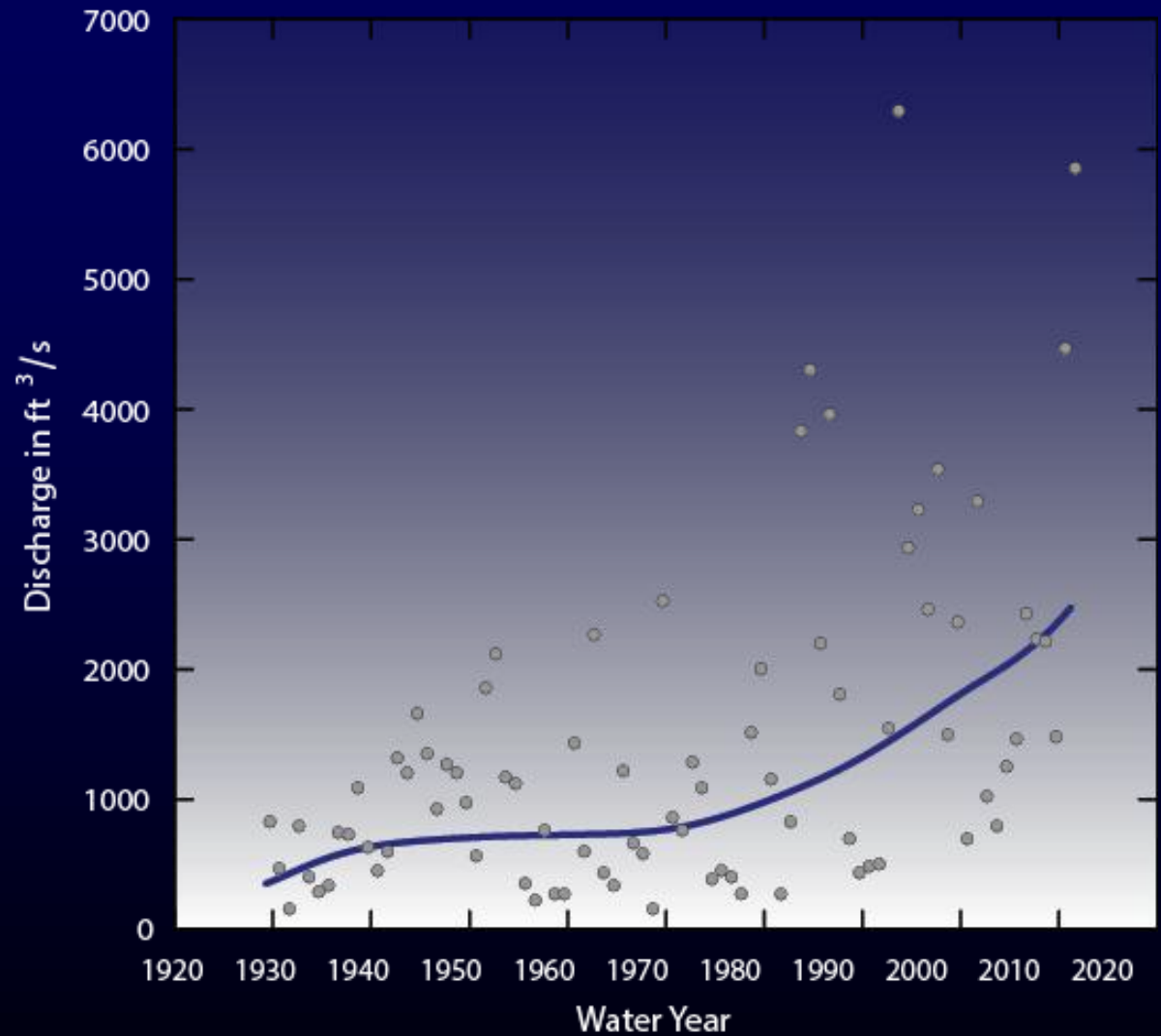
90% Confidence





Big Sioux River at Akron, 1929-2011

Mean

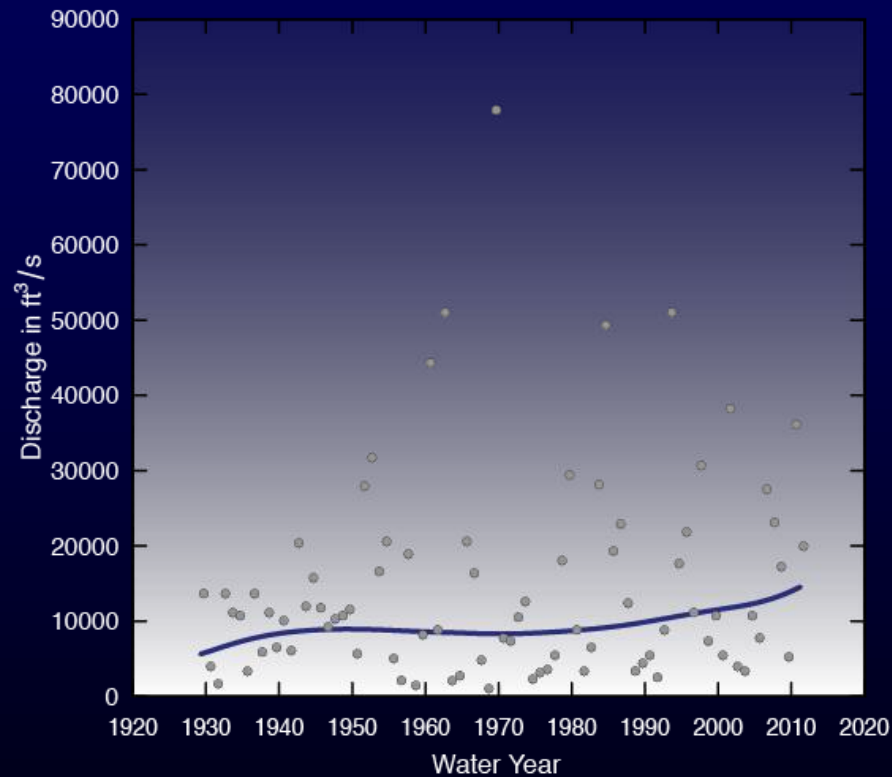




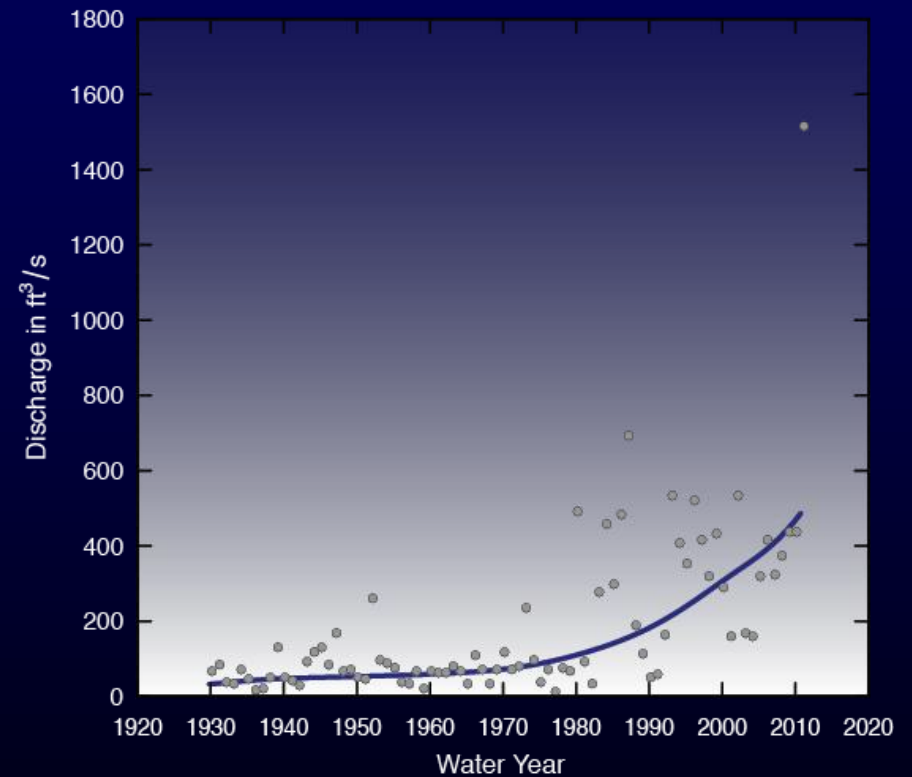
Big Sioux River at Akron 1929-2011

Slide 12

1-day maximum

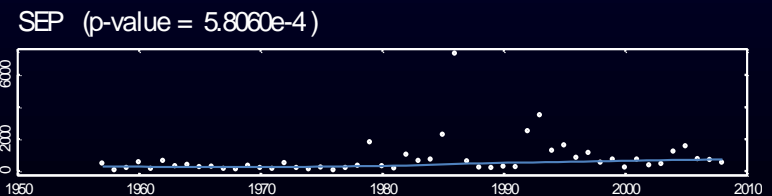
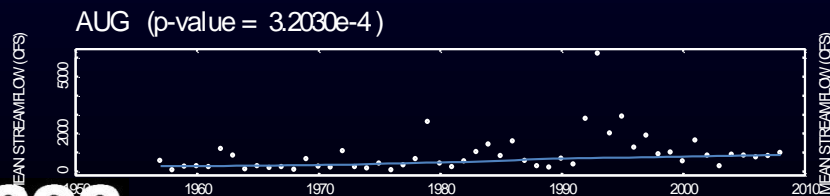
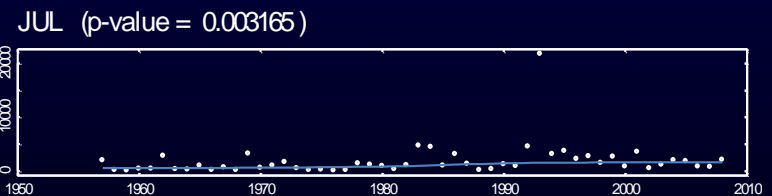
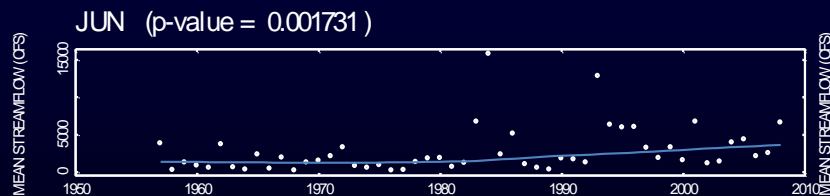
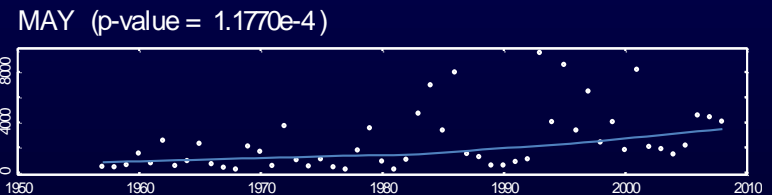
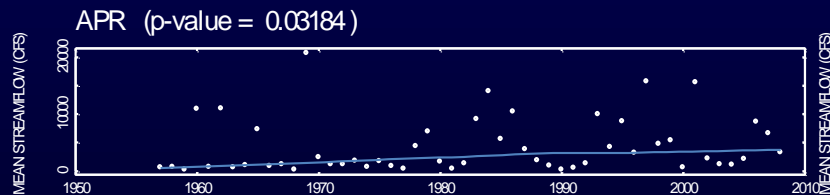
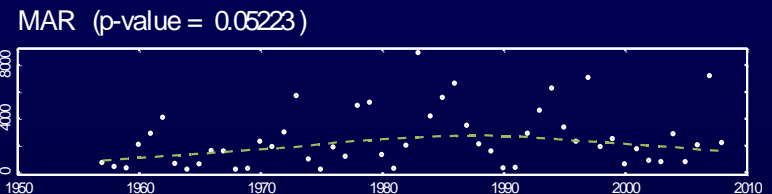
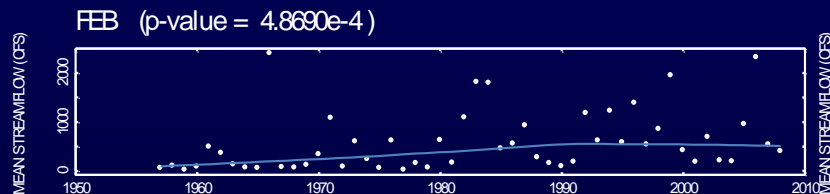
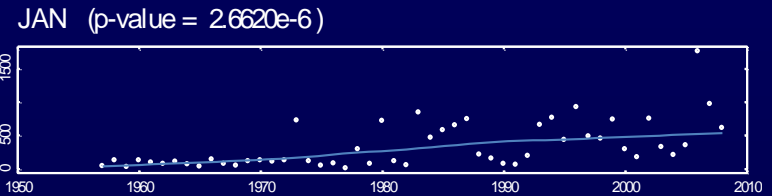
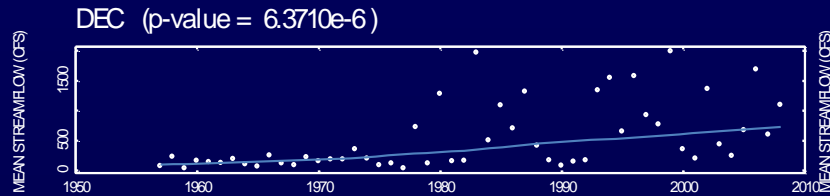
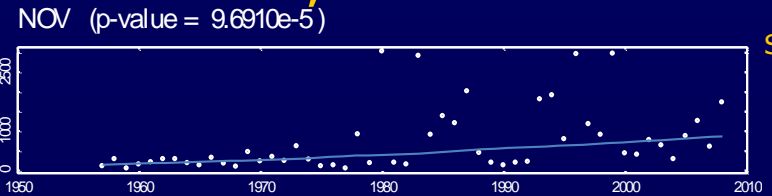
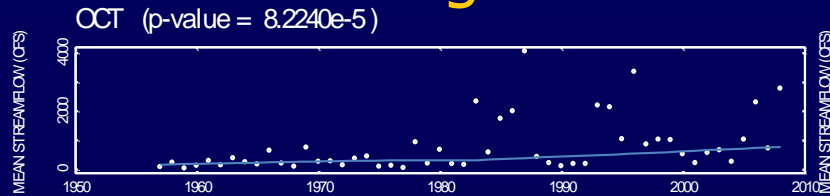


7-day minimum



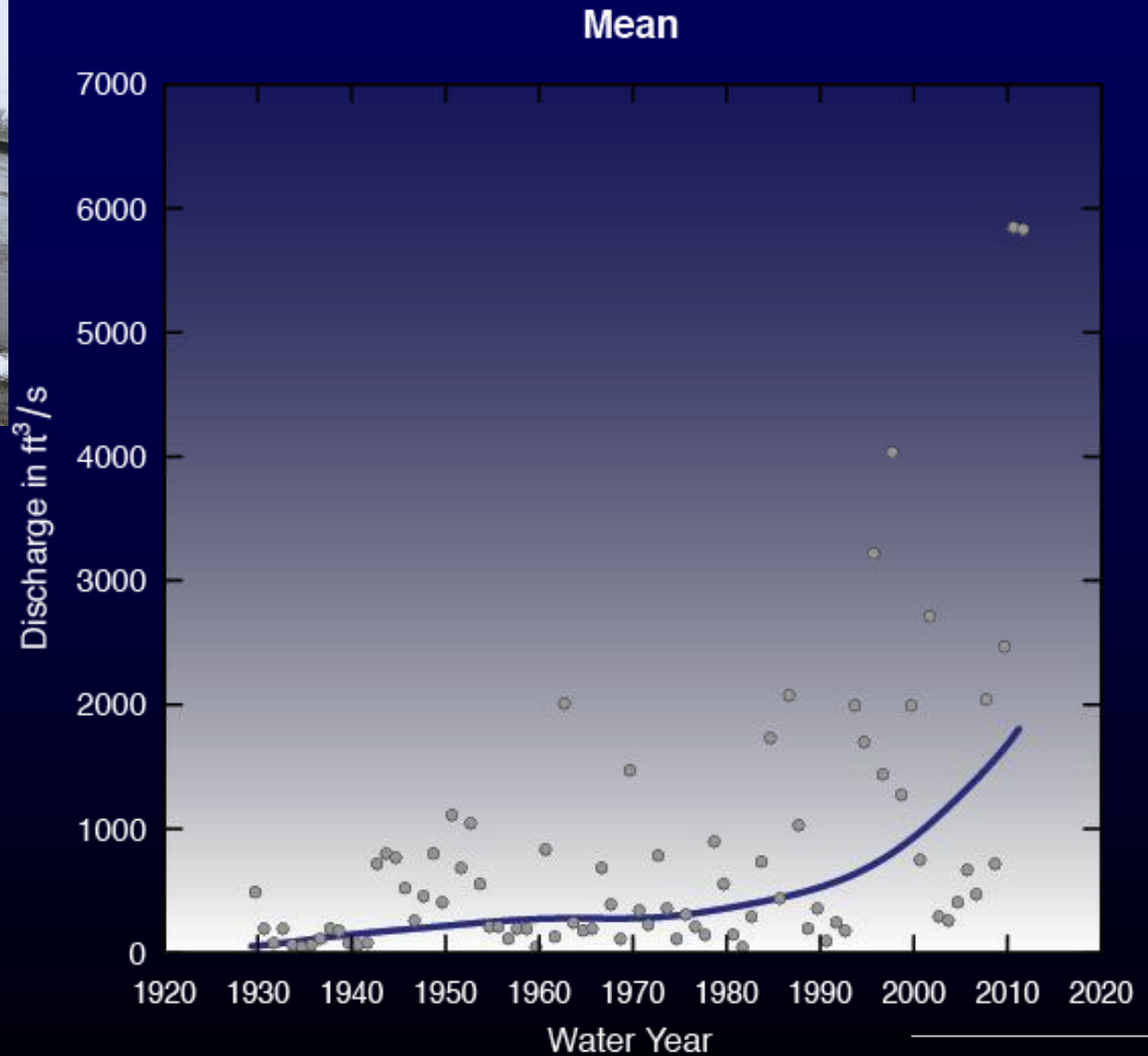
Big Sioux River at Akron, IA

Slide 13





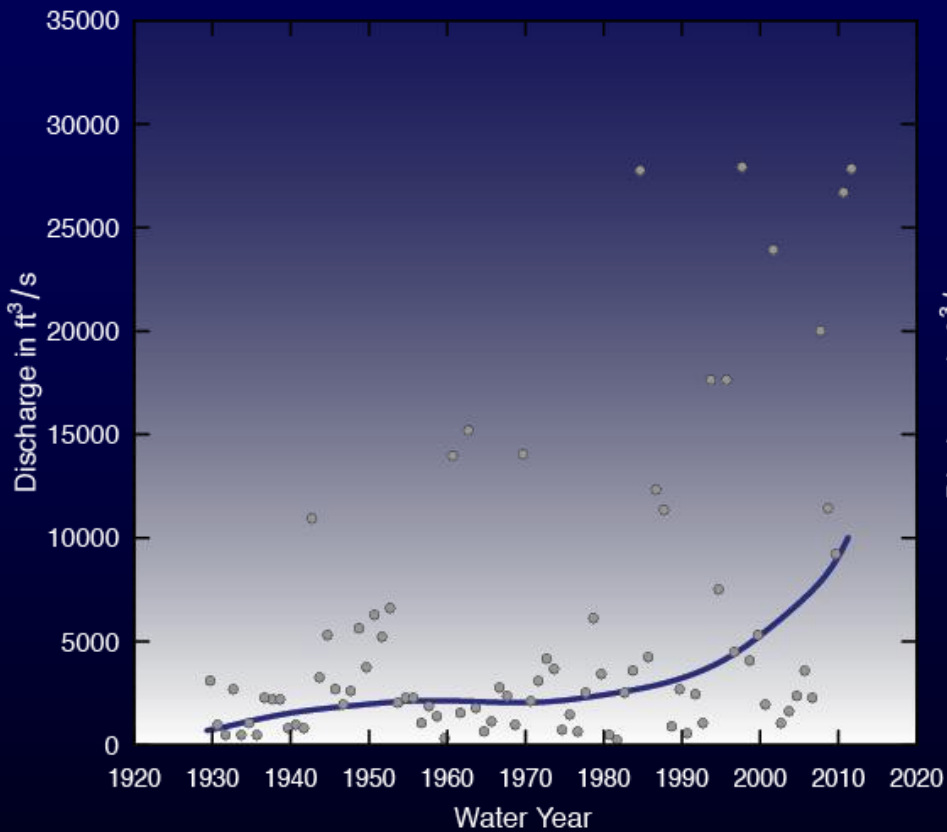
James River nr Scotland, 1929-2011



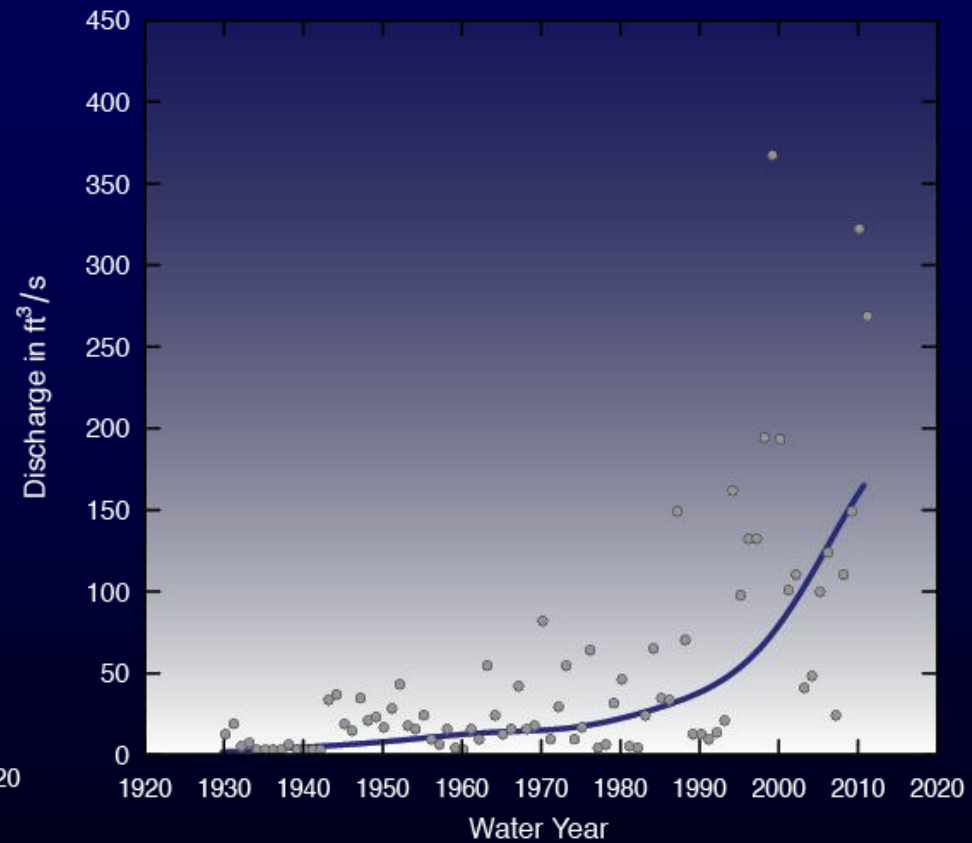


James River near Scotland 1929-2011

1-day maximum

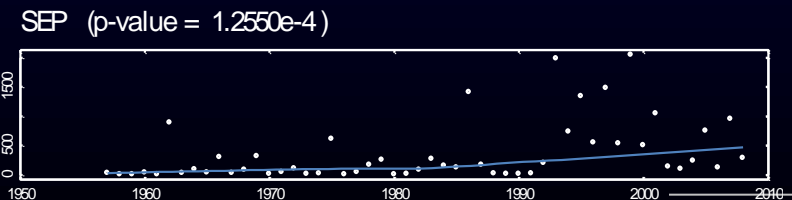
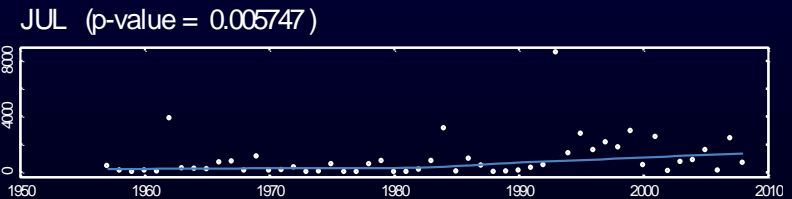
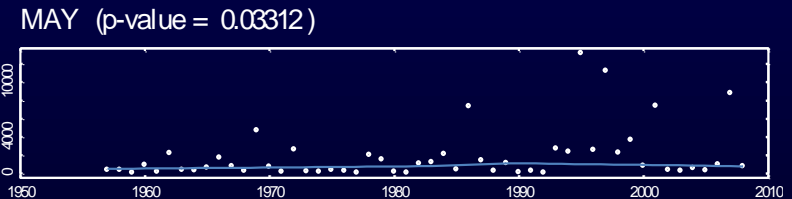
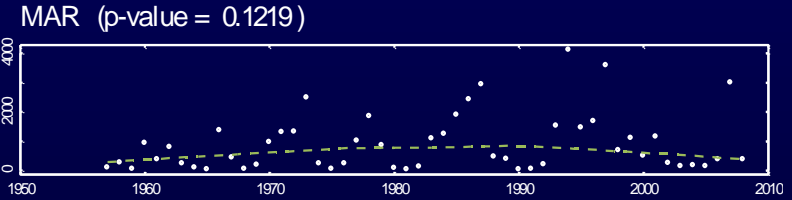
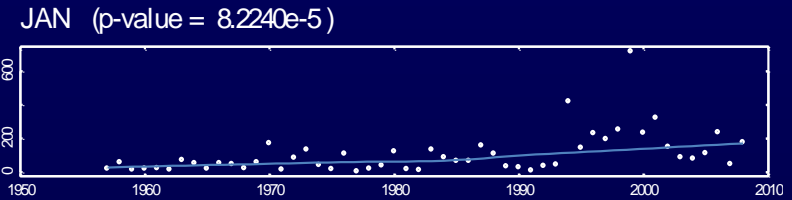
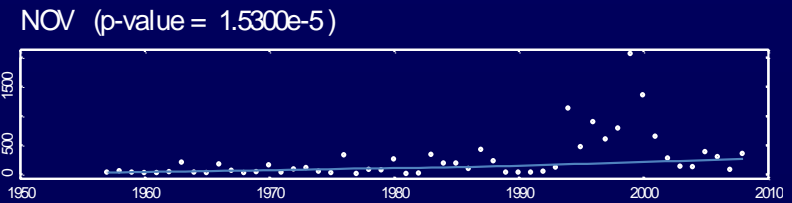
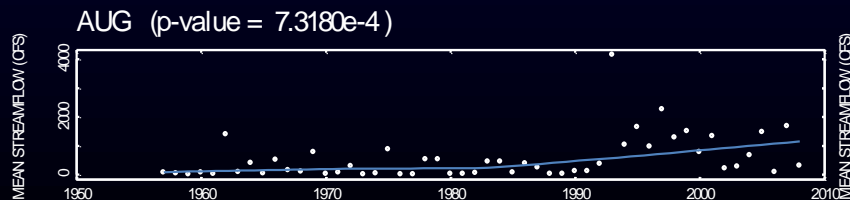
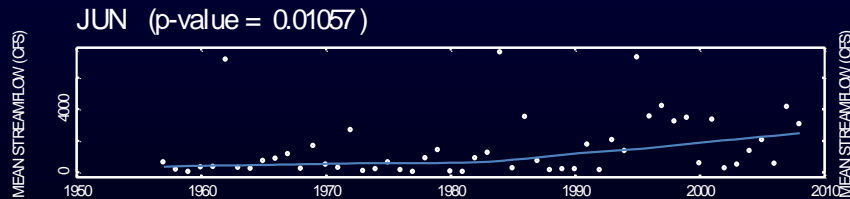
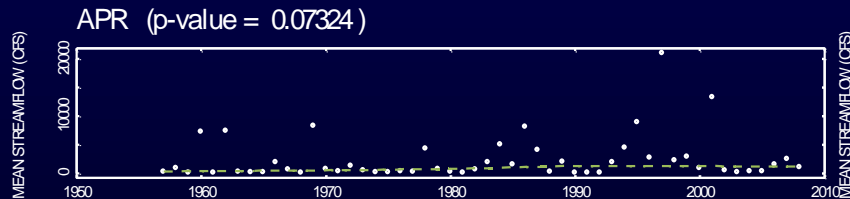
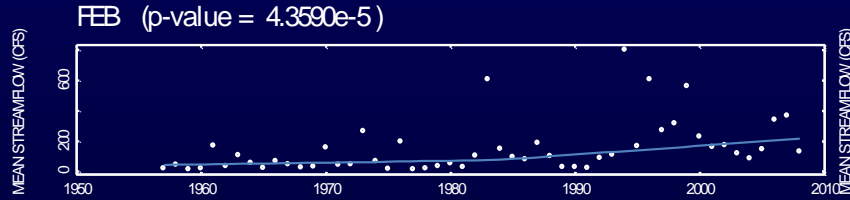
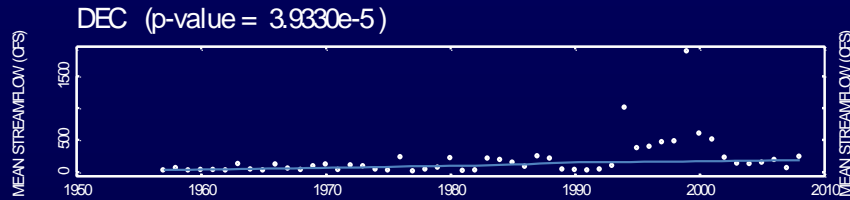
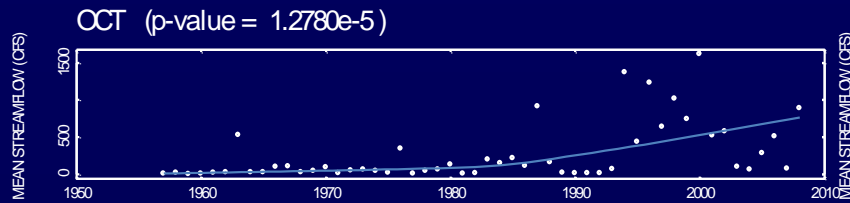


7-day minimum



James River nr Scotland, SD

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Waubay Lake Historical Water Levels (Letters link to Images)

Slide 17

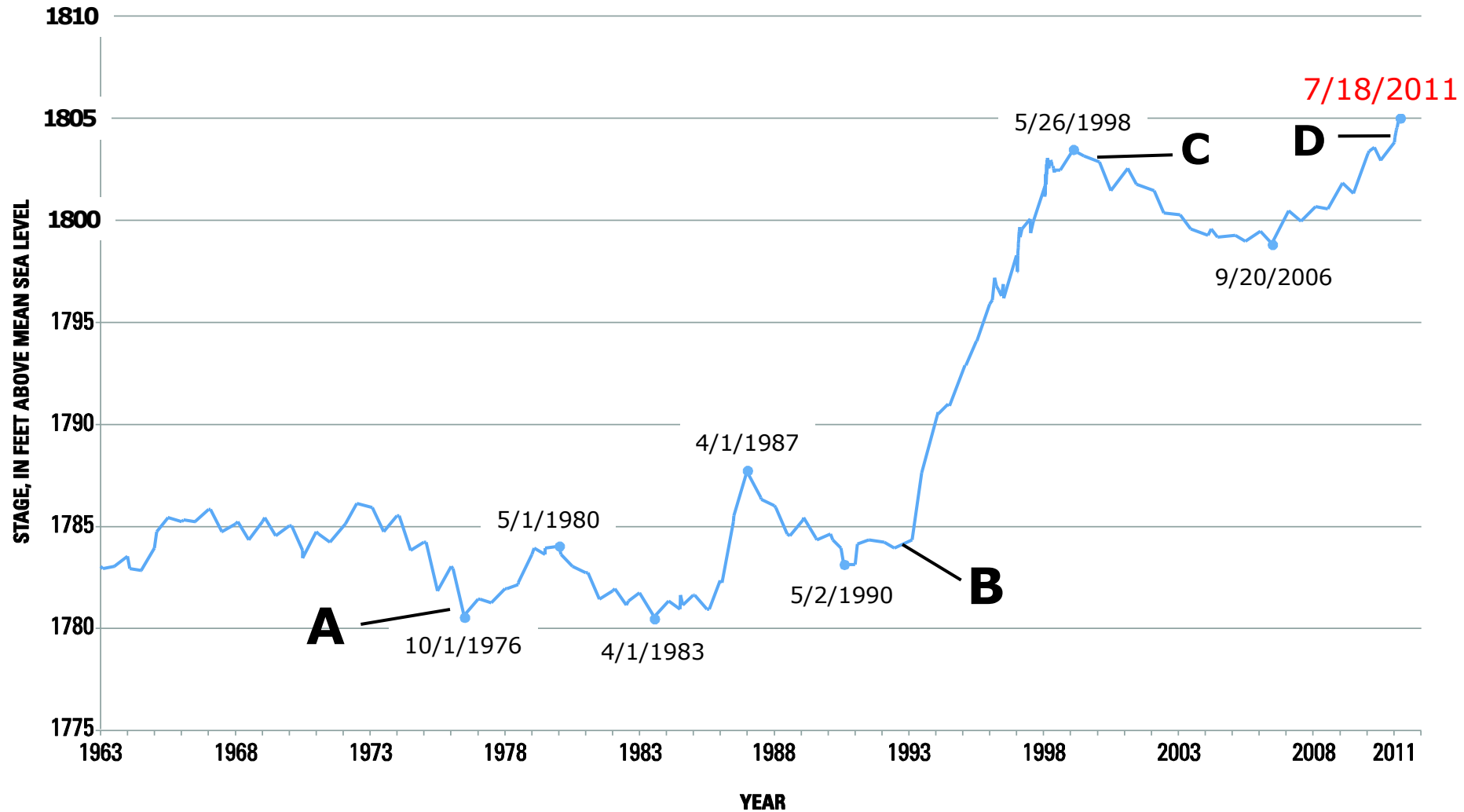
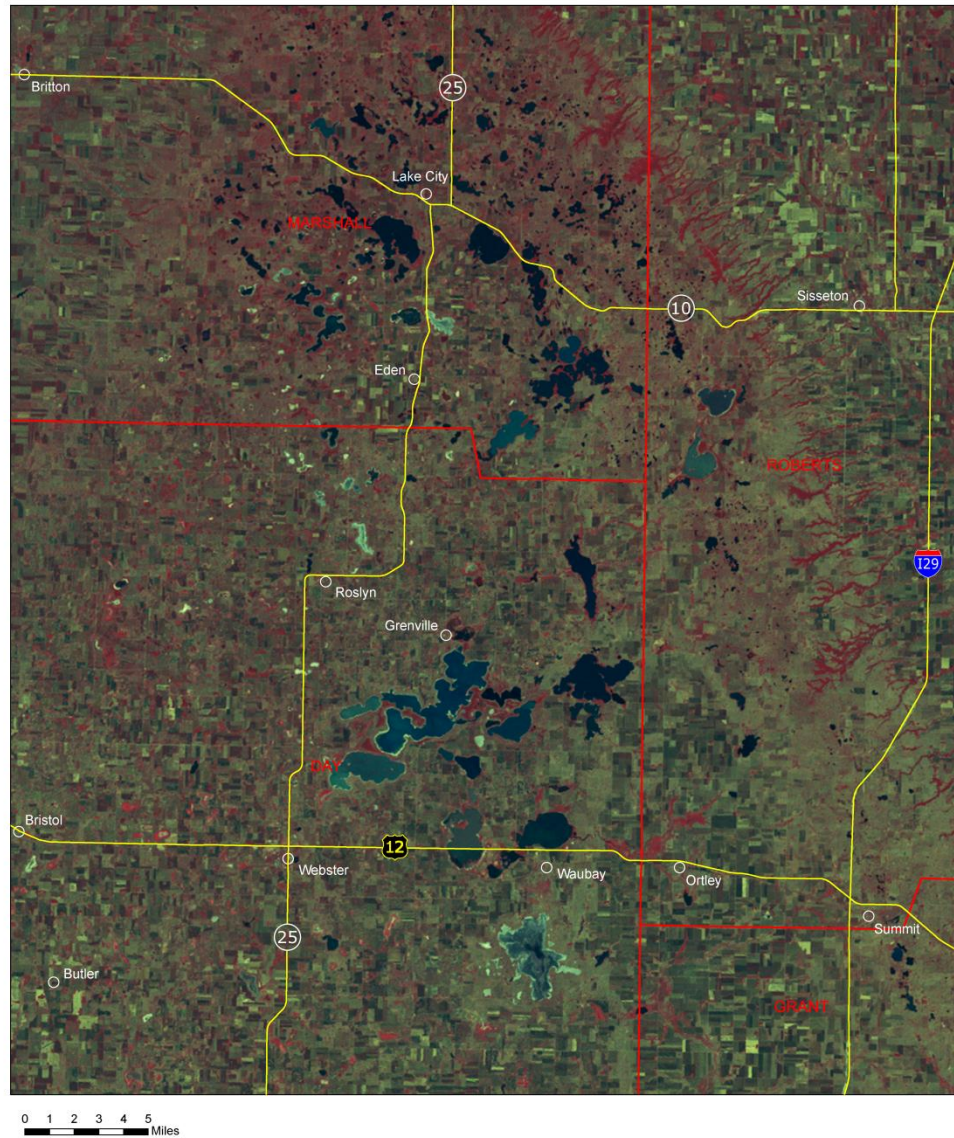


Image A—Day County, South Dakota 1976

July 17, 1976



59.2 mi² of water

Image B—Day County, South Dakota 1992

August 10, 1992

70.9 mi² of water

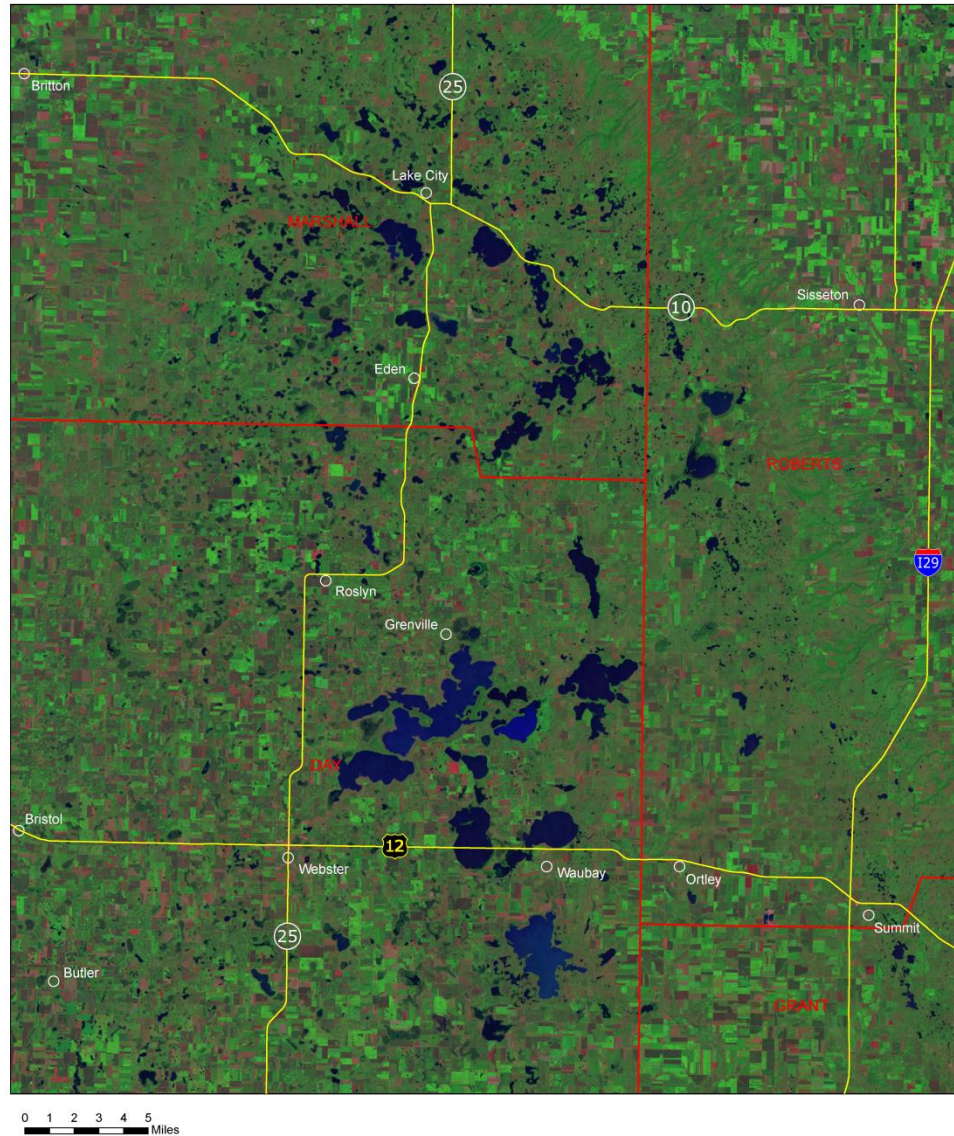
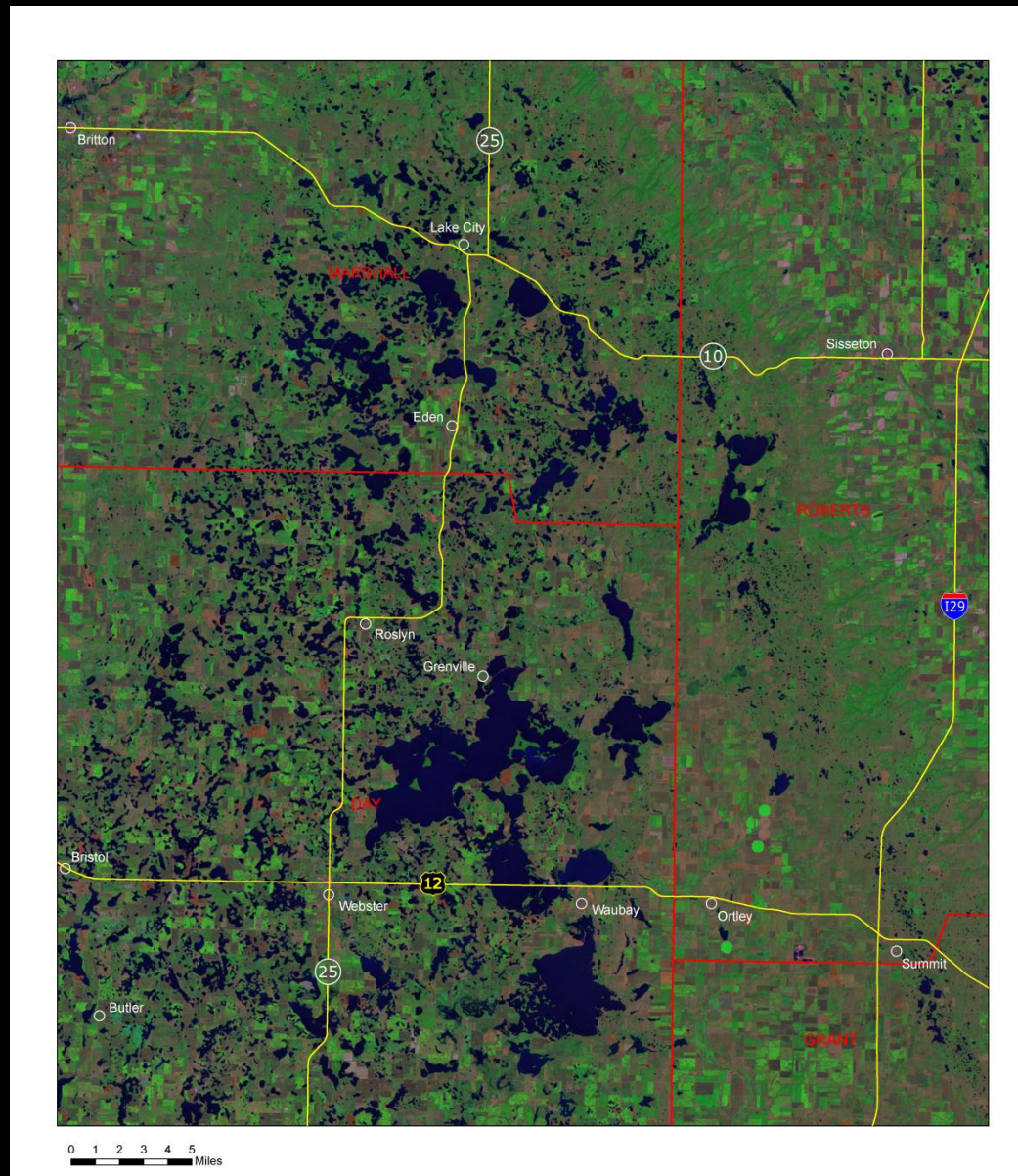


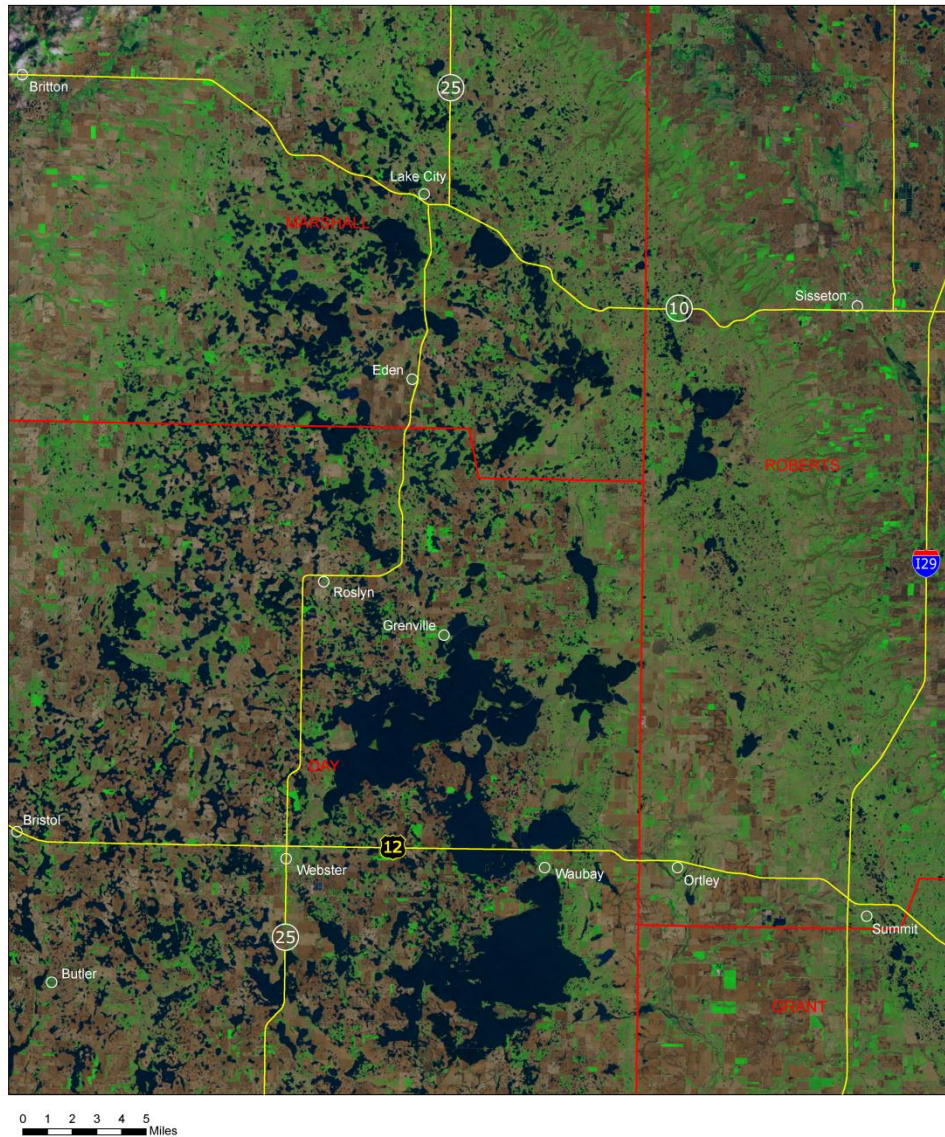
Image C—Day County, South Dakota 1998



July 26, 1998

200.9 mi² of water

Image D—Day County, South Dakota 2011

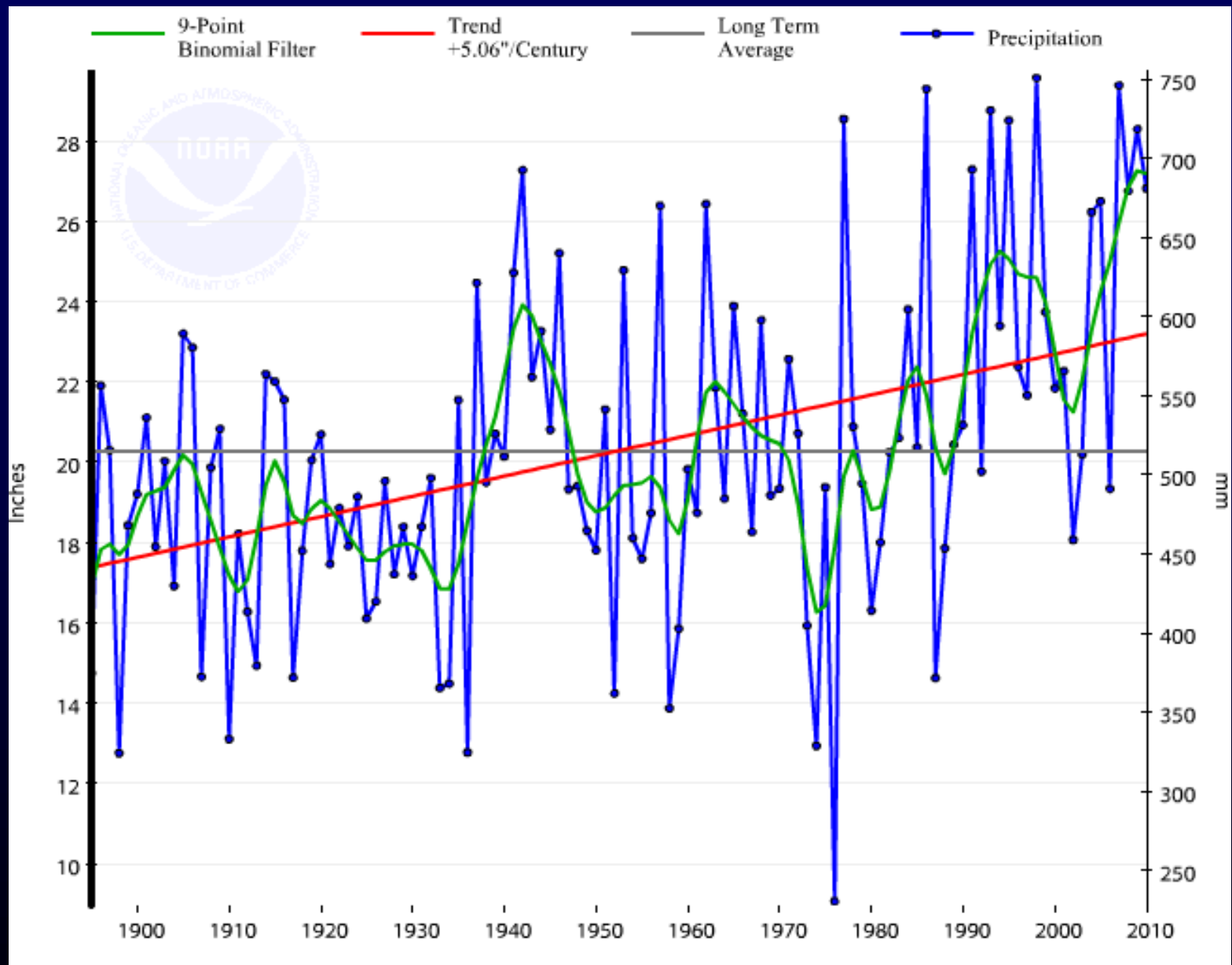


May 11, 2011

216.5 mi² of water

1895-2010 Precipitation Record for NE South Dakota

Slide 22



*Installation with
a Tile Plow*

Slide 23



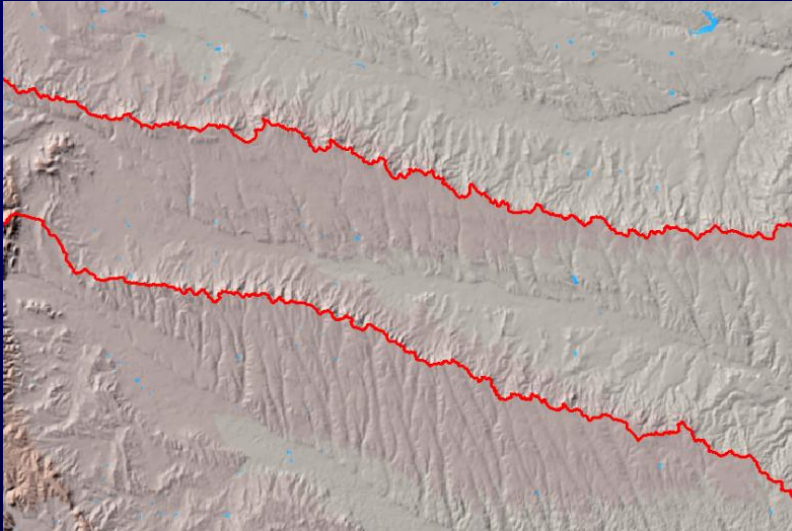
Definition of "Watershed"

Slide 24

- An area of land having a topographically-defined boundary, and surface drainage flowing toward a common area or single outlet.
 - Similar terms: Drainage basin, Catchment, Hydrologic Unit
 - John Wesley Powell, cartographer/explorer:
"That area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community."
-

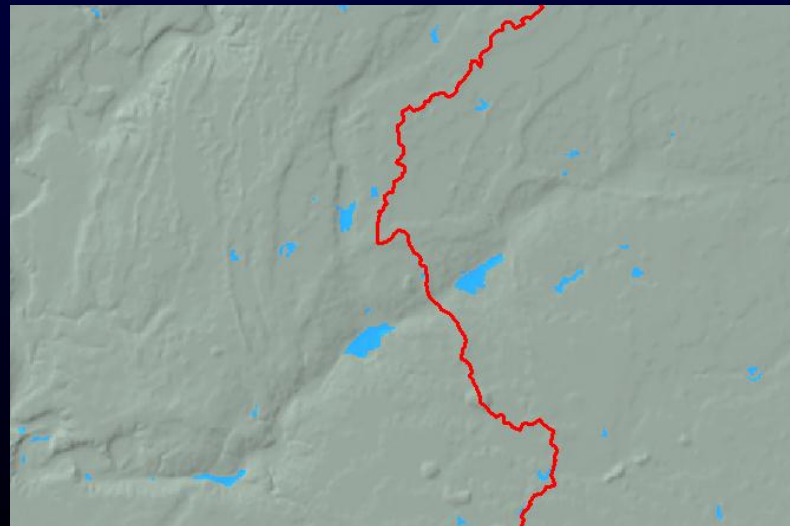
Watershed boundaries are defined by topographic high points

Slide 25



Boxelder Creek basin in western SD

Medicine Knoll Creek (near Blunt)

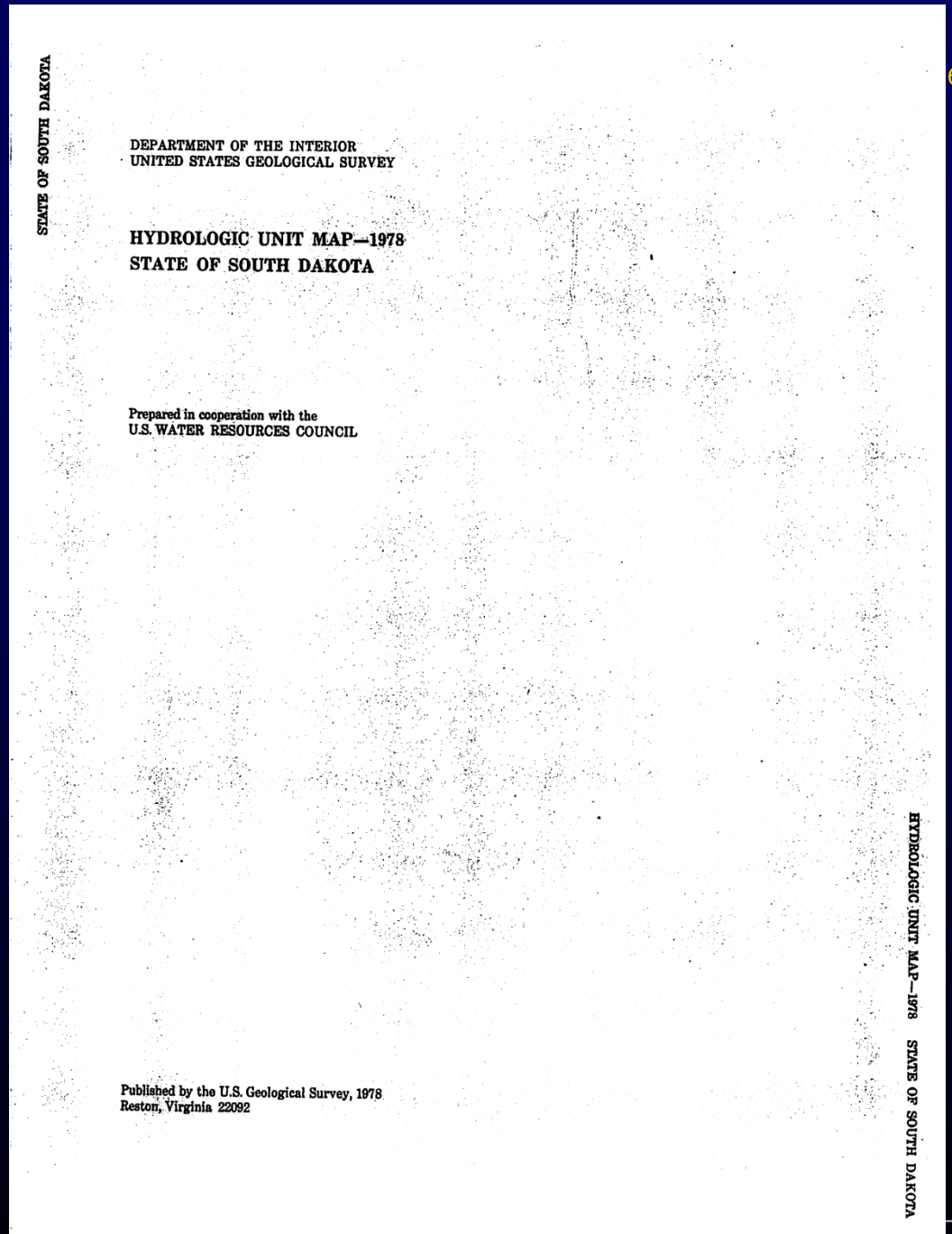


Wolf Creek (within James River Basin)

1978 USGS Hydrologic Unit Map

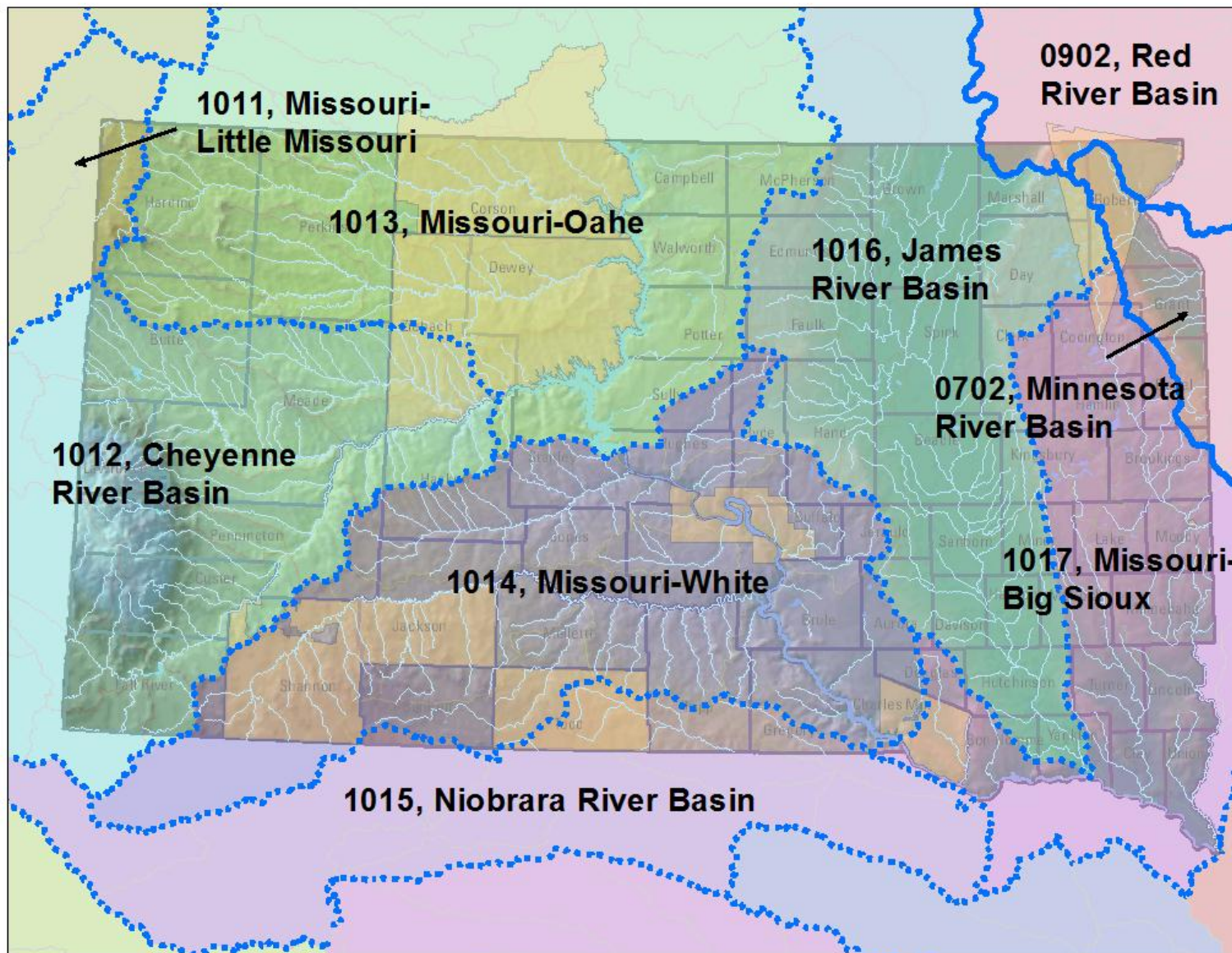
(not superseded until
2008)

- Map scale is 1:500,000
- Watershed boundaries are based on 1:250,000 scale contours



"4-digit" Hydrologic Units

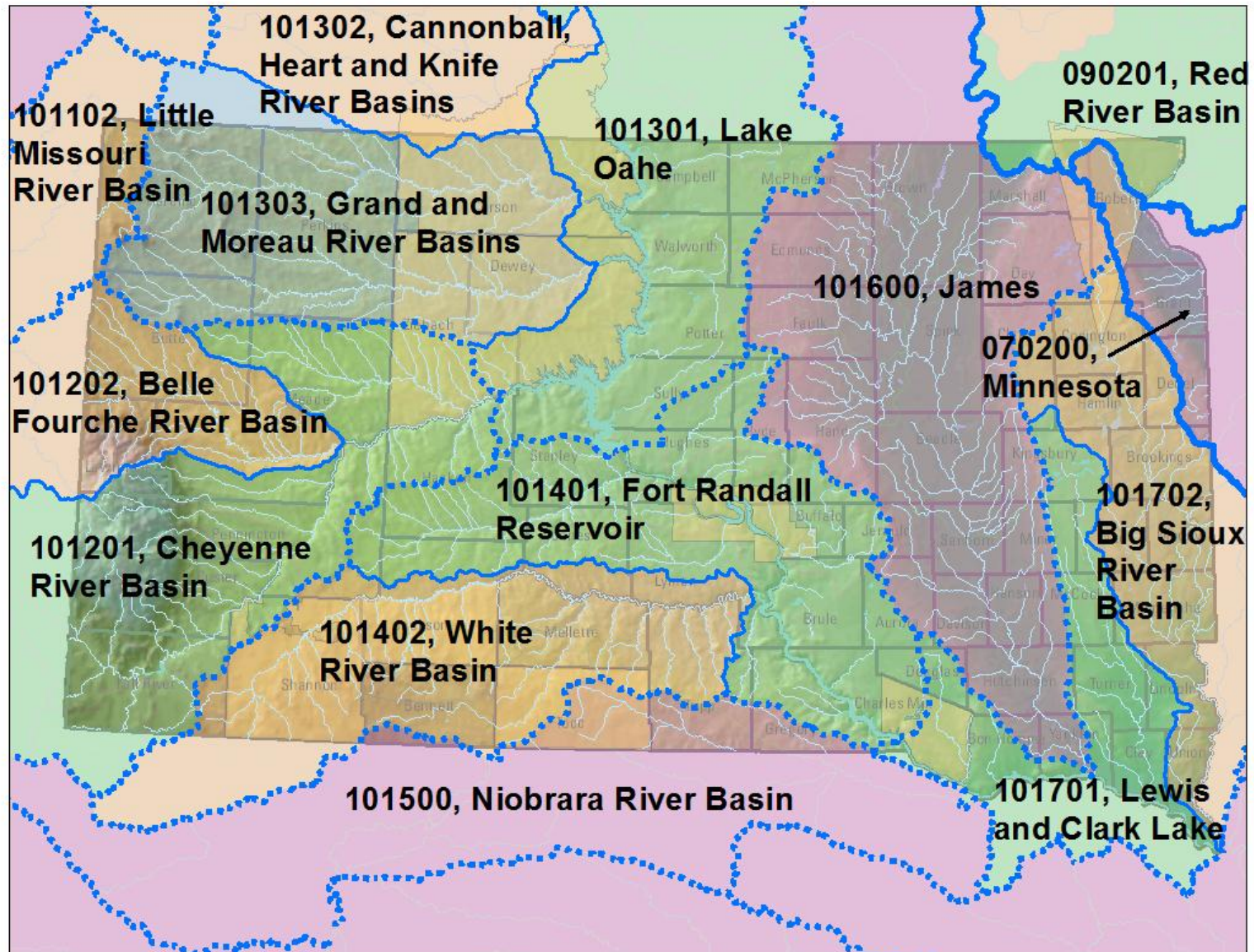
Slide 27



Continental
divide

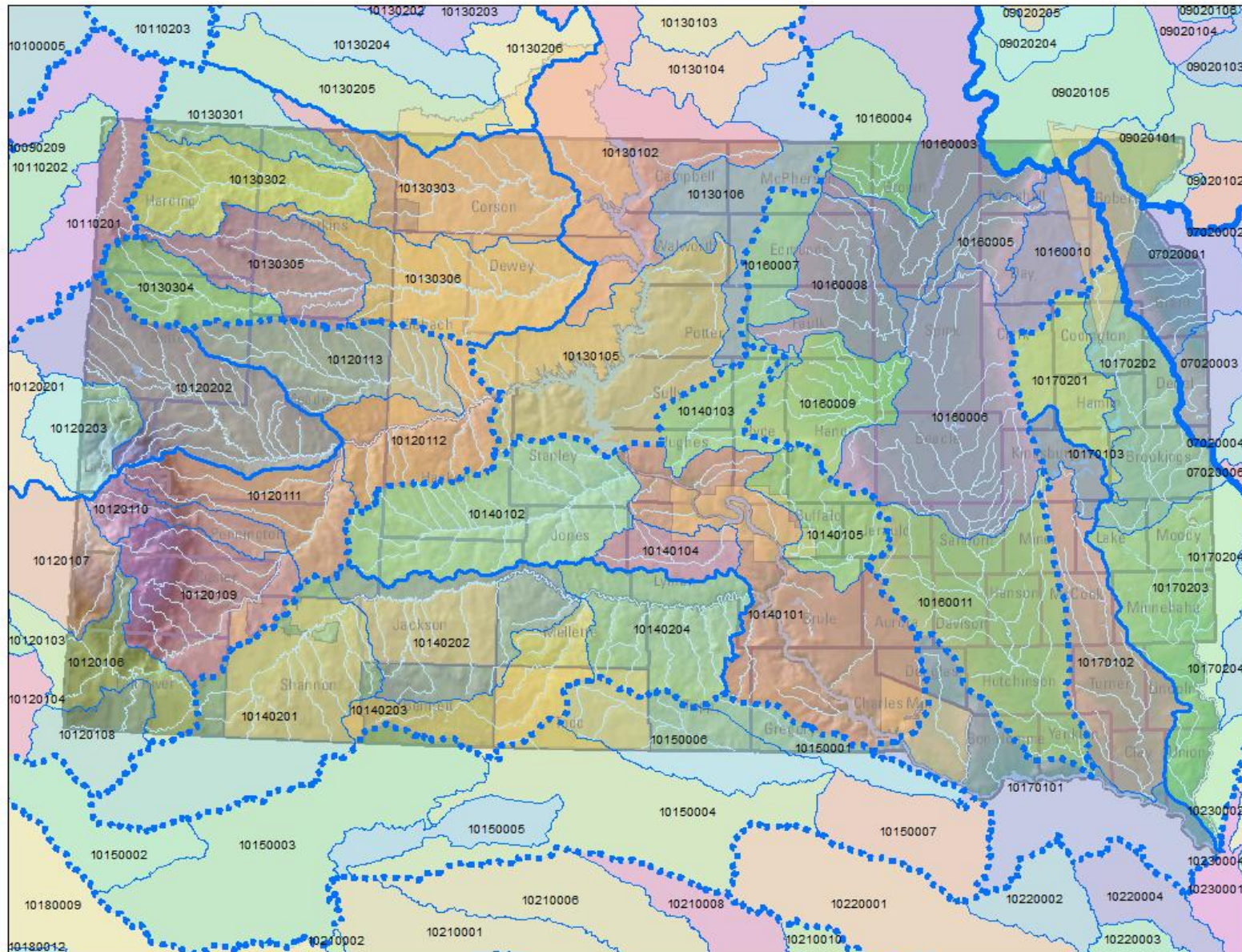
6-digit Hydrologic Units

Slide 28



8-digit Hydrologic Units

Slide 29



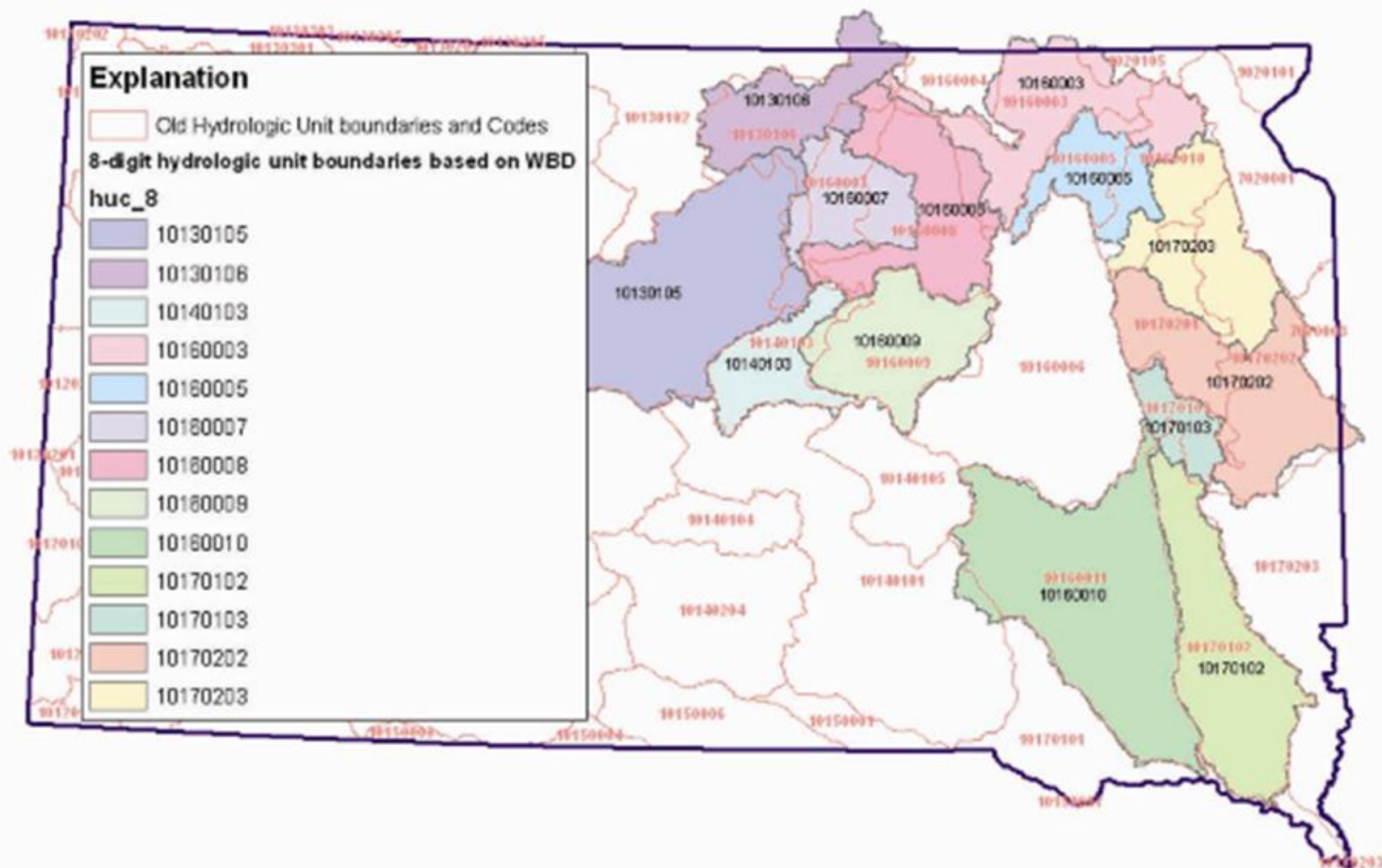
The “current” standard in SD – the digital Watershed Boundary Dataset (WBD)

Slide 30

- Available nationally
 - Completed in 2008 for SD
 - Interagency effort (USGS and NRCS)
- Higher resolution (based on 1:24,000 contours)
- Further subdivided into 10- and 12-digit units
- Maintains same nesting structure and coding scheme
- Managed nationally with maintenance by State WBD Stewards

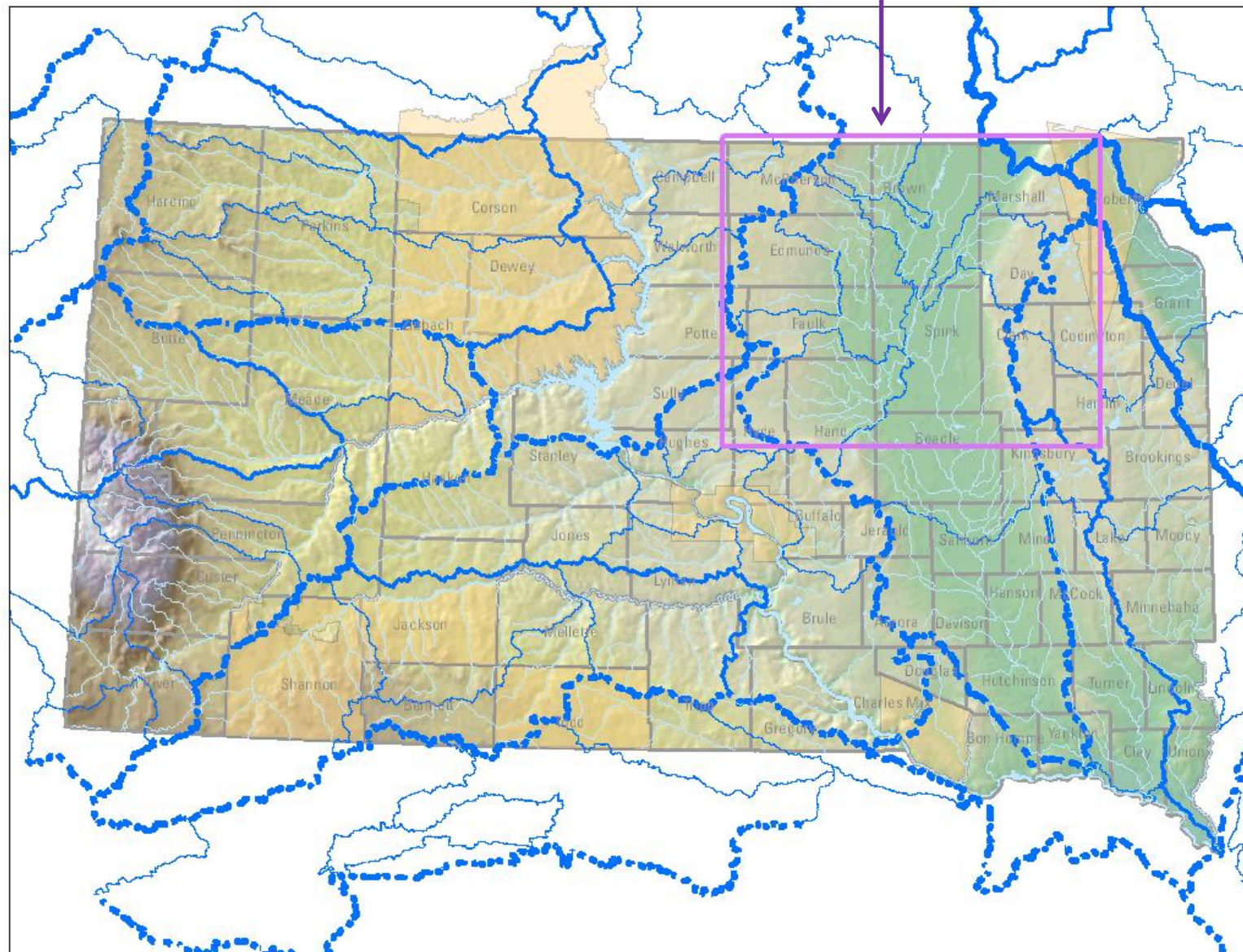
Major changes in watershed boundaries from WBD

Slide 31



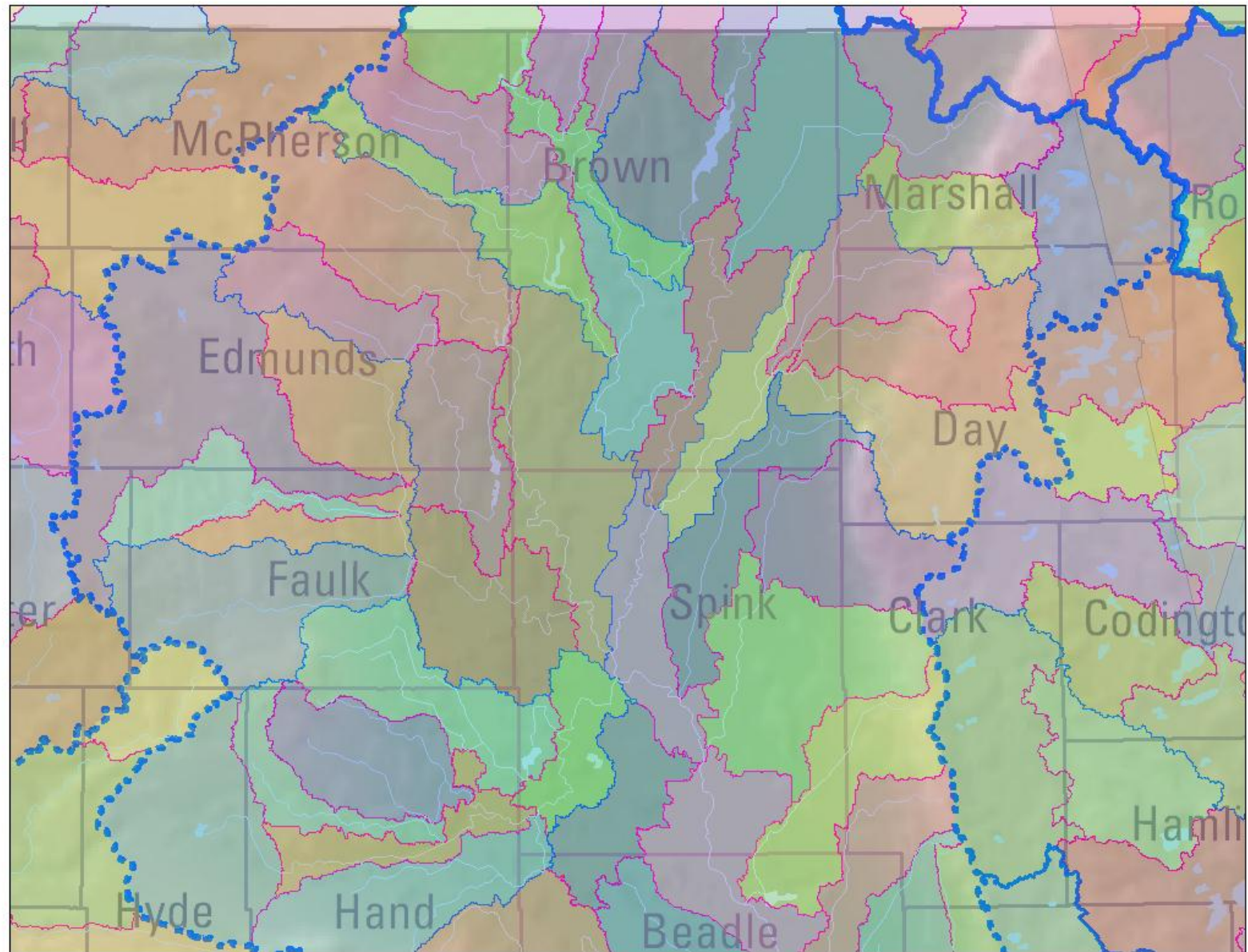
8-digit units – next slides will show 10- and 12-digit units for the outlined area

Slide 32



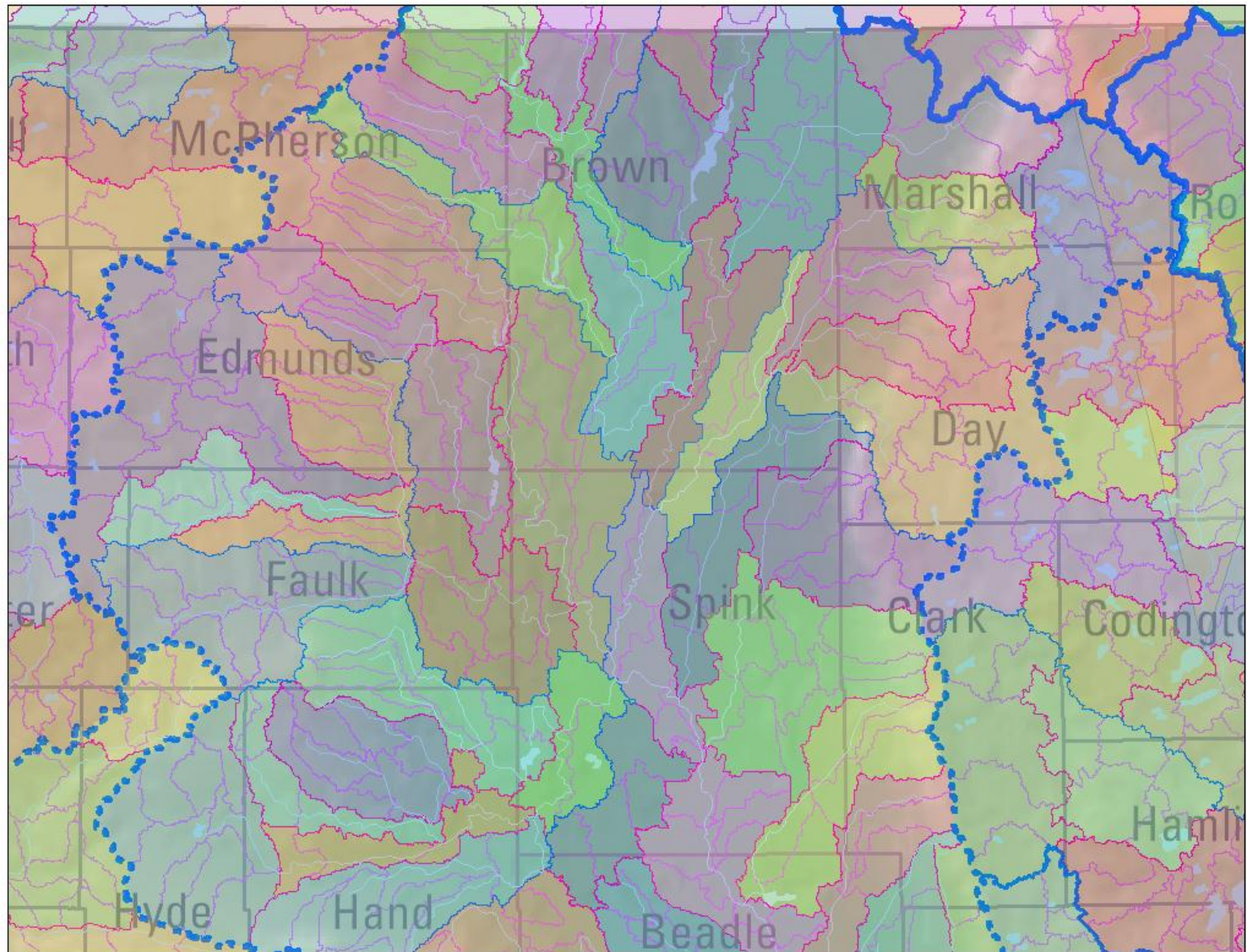
10-digit Hydrologic Units

Slide 33



12-digit Hydrologic Units

Slide 34



Looking to the Future: High-Resolution Hydrographic Mapping using Lidar

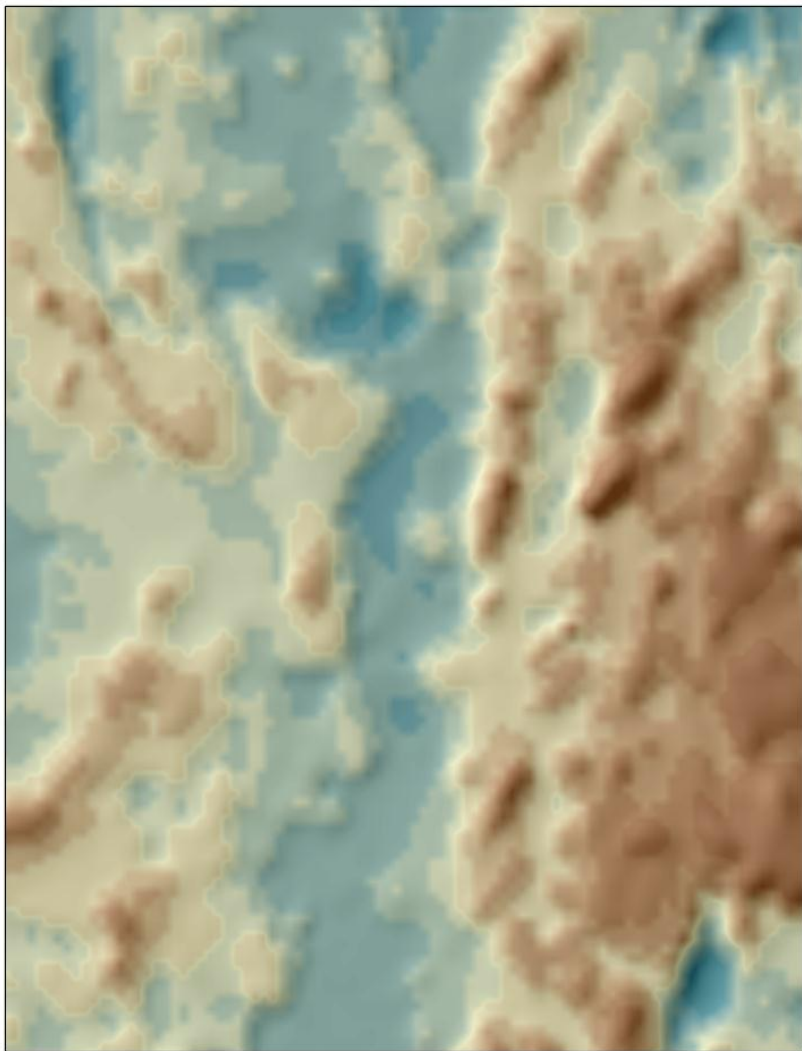
Slide 35

- ☒ What is Lidar? (Light detection and ranging)
- ☒ Can be used to build high-resolution elevation models (3-meter cell size)

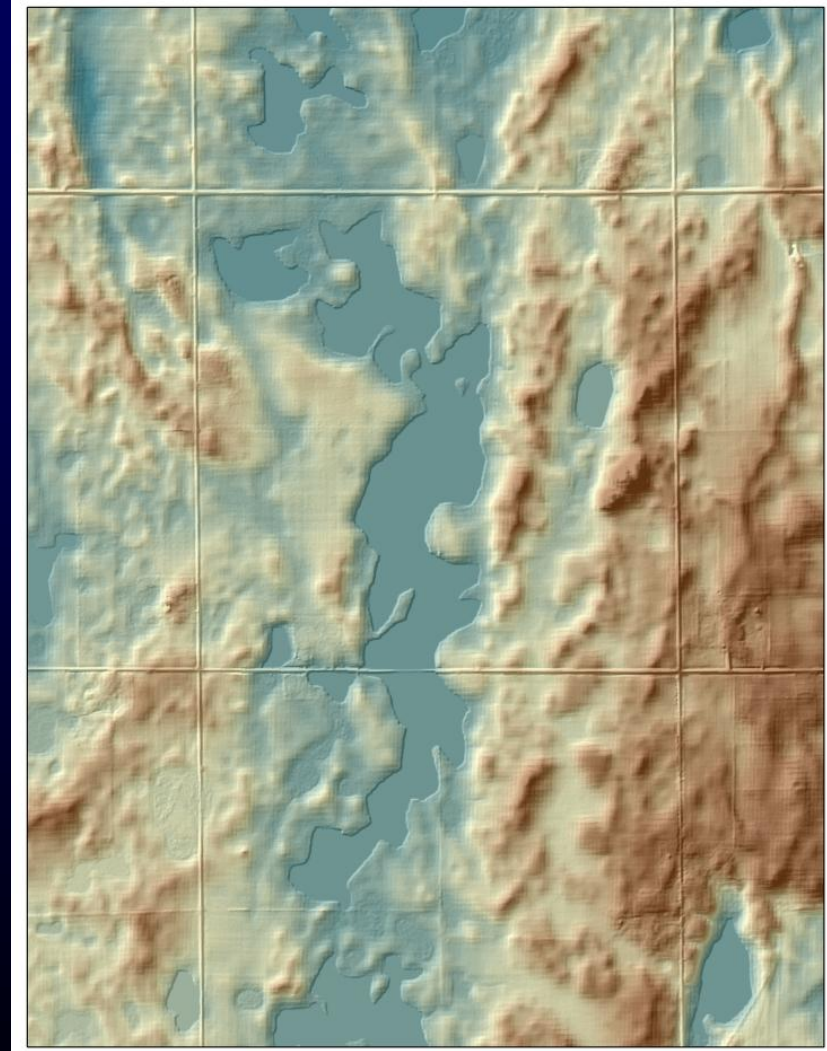
Elevation data: Previous versus Lidar

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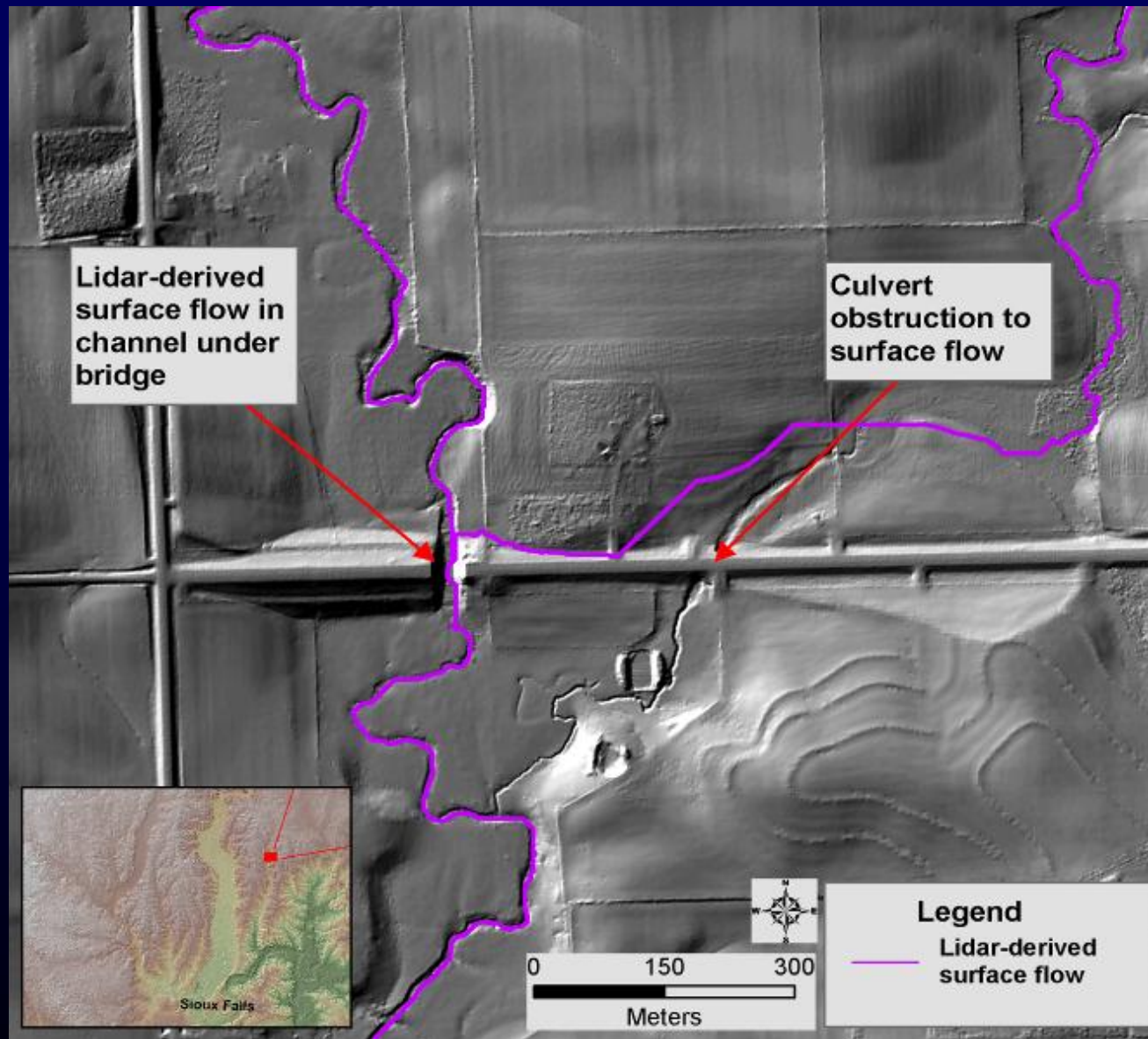
30 meter cell size



3 meter cell size

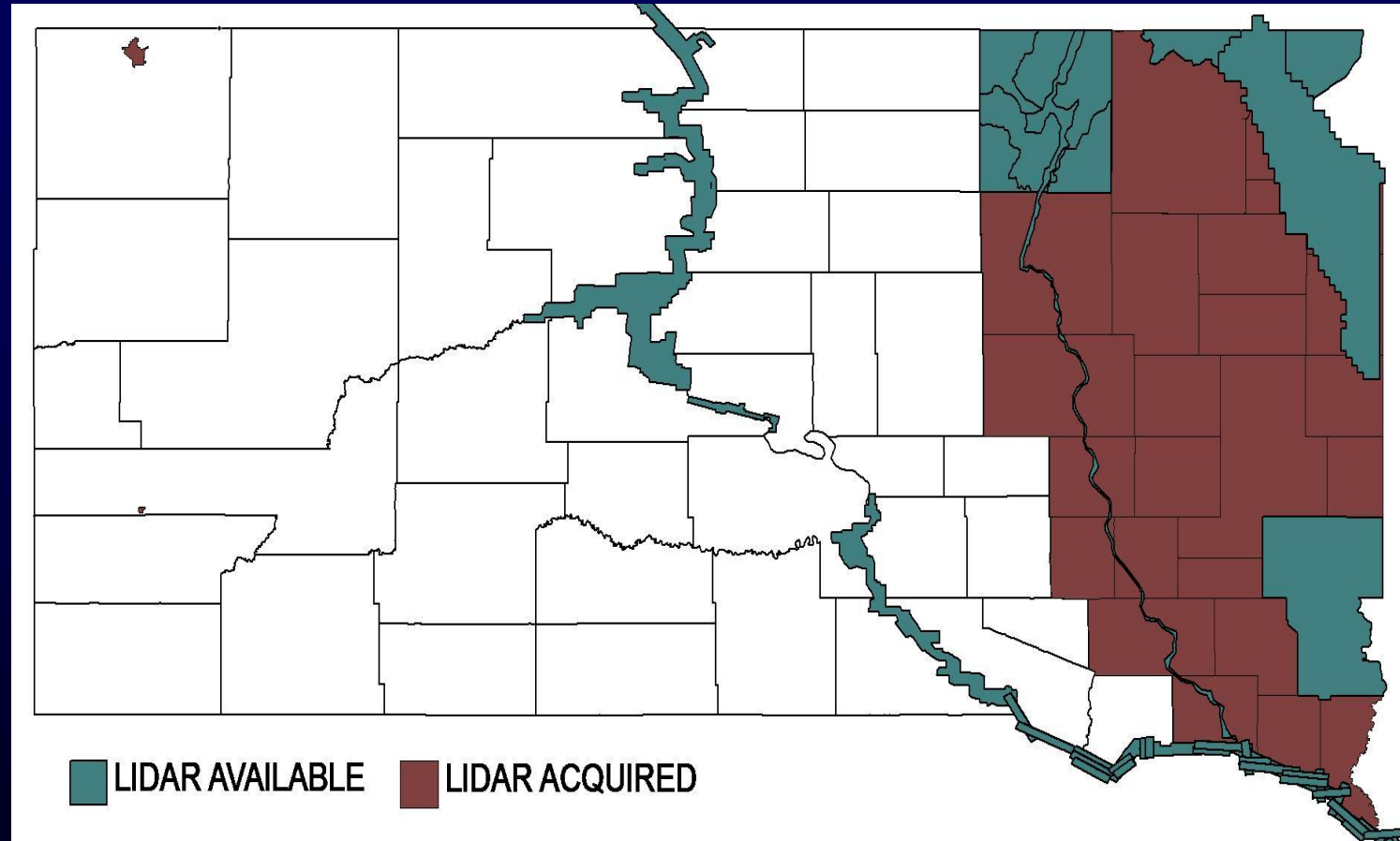


Hydro-enforcement (deals with culvert locations, etc) Slide 37





Areas of Lidar availability

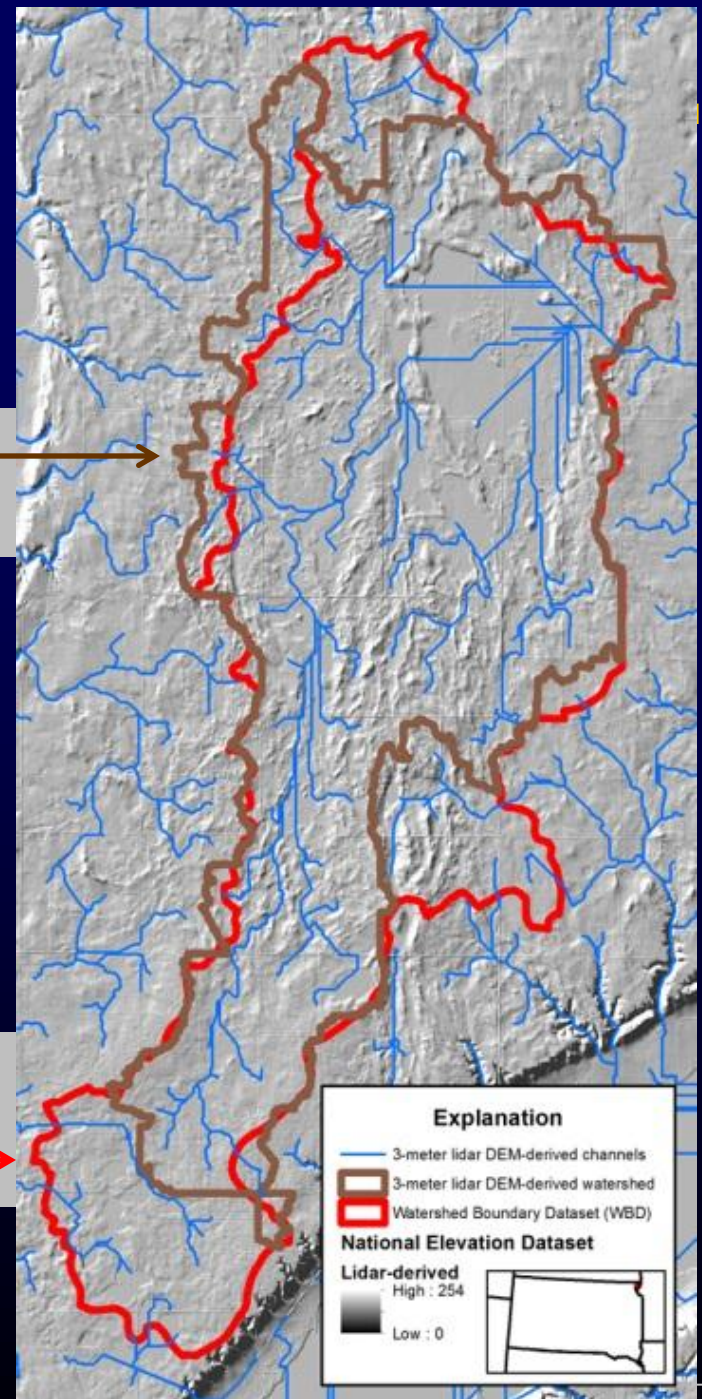


Low-relief test area

In northeastern SD near Lake Traverse

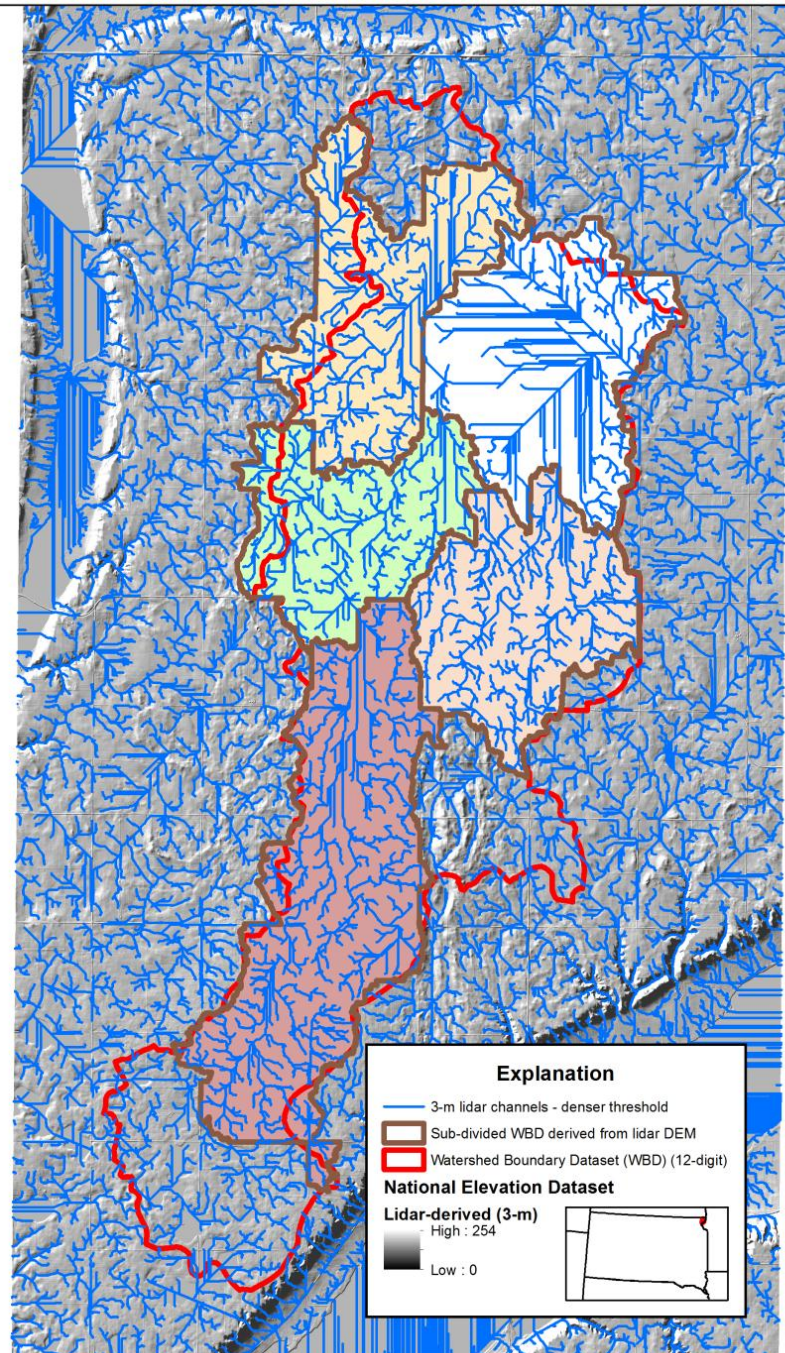
Brown line is based on Lidar data

Red line is 12-digit unit from WBD
(based on contour map)



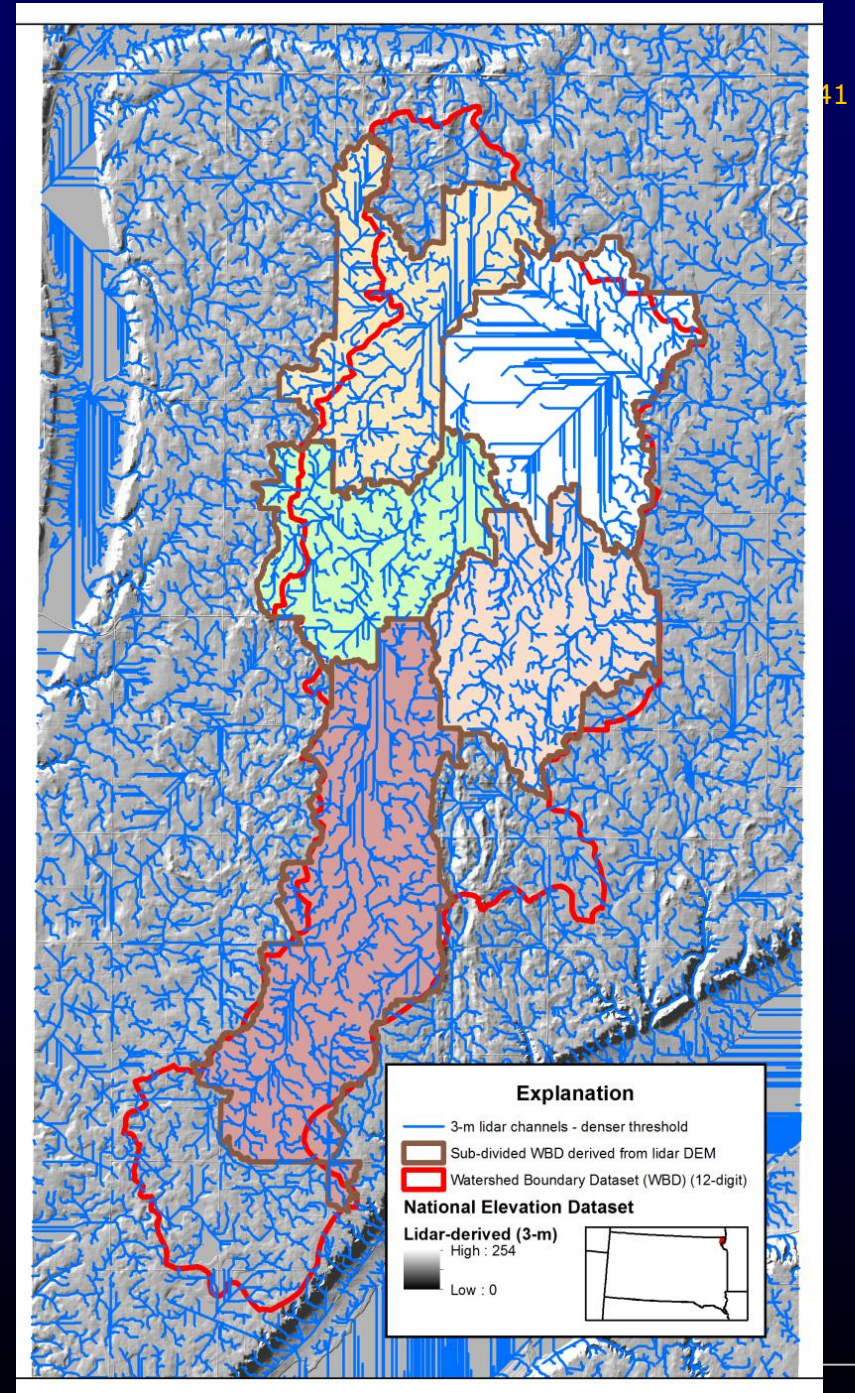
Low-relief test area

- Colored areas are possible 14-digit units
- Can be further divided into 16-digit units
- Some very important features:
 - “Densification” of the drainage network ... display thresholds can be selected
 - Similar capabilities for display of watershed boundaries

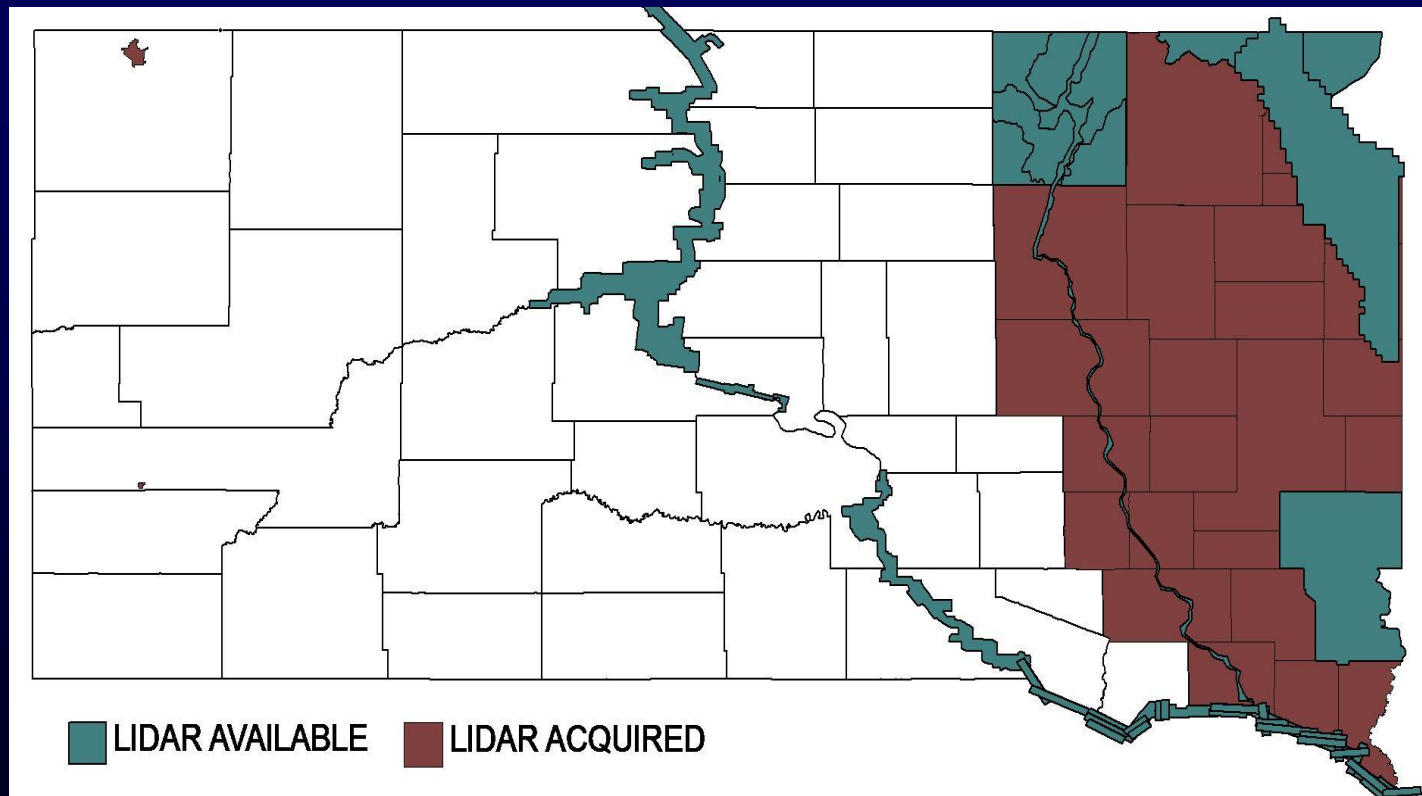


Why would this be useful?

- Immense efficiency
 - Develop standardized map products as soon as Lidar datasets become available
 - The high-resolution map products would be used repeatedly for many future purposes
- A concept paper for doing this work has been developed



Currently working on a proposal for a pilot project near Sioux Falls





Conclusions

❖ Lake Elevations

- ❖ Many lakes at historical max elevations
- ❖ Waubay system may spill into Big Sioux
- ❖ Precipitation increases a large factor

❖ Streamflow

- ❖ Annual increases profound in Big Sioux and James
- ❖ Winter increases in flow
- ❖

❖ Surface Temperature

- ❖ Temperatures have increased, especially winter minimums

❖ Trends in place